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STATE DOCUMENTS

ROAD CONSTRUCTION STANDARDS

MONTANA
STATE HIGHWAY COMMISSION
HELENA MONTANA

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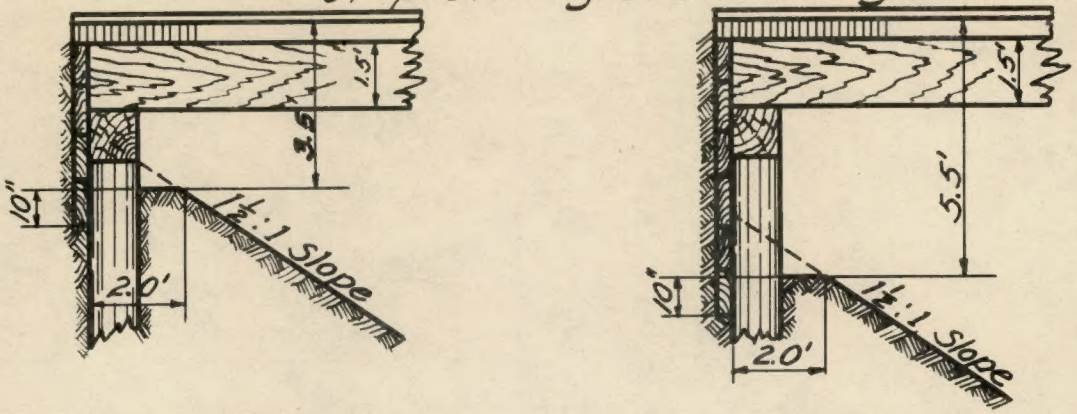
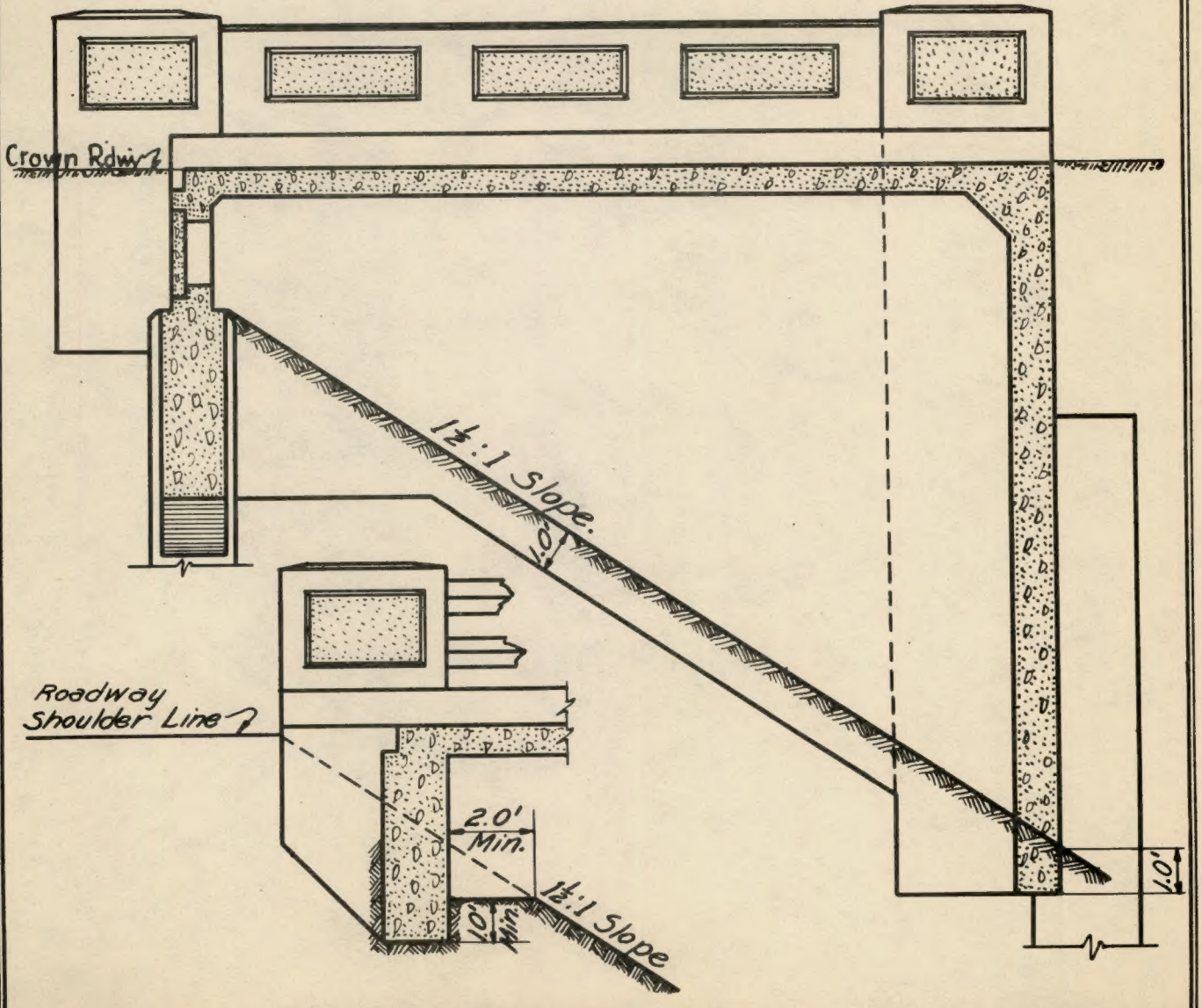
BRIDGE BERMS

NOTE:- See Std. Drawings for relation of profile grade to fin. grade.



TYPE A TYPE B

BERM AT PILE BRIDGE ENDS



BERM AT CONCRETE BRIDGE ENDS

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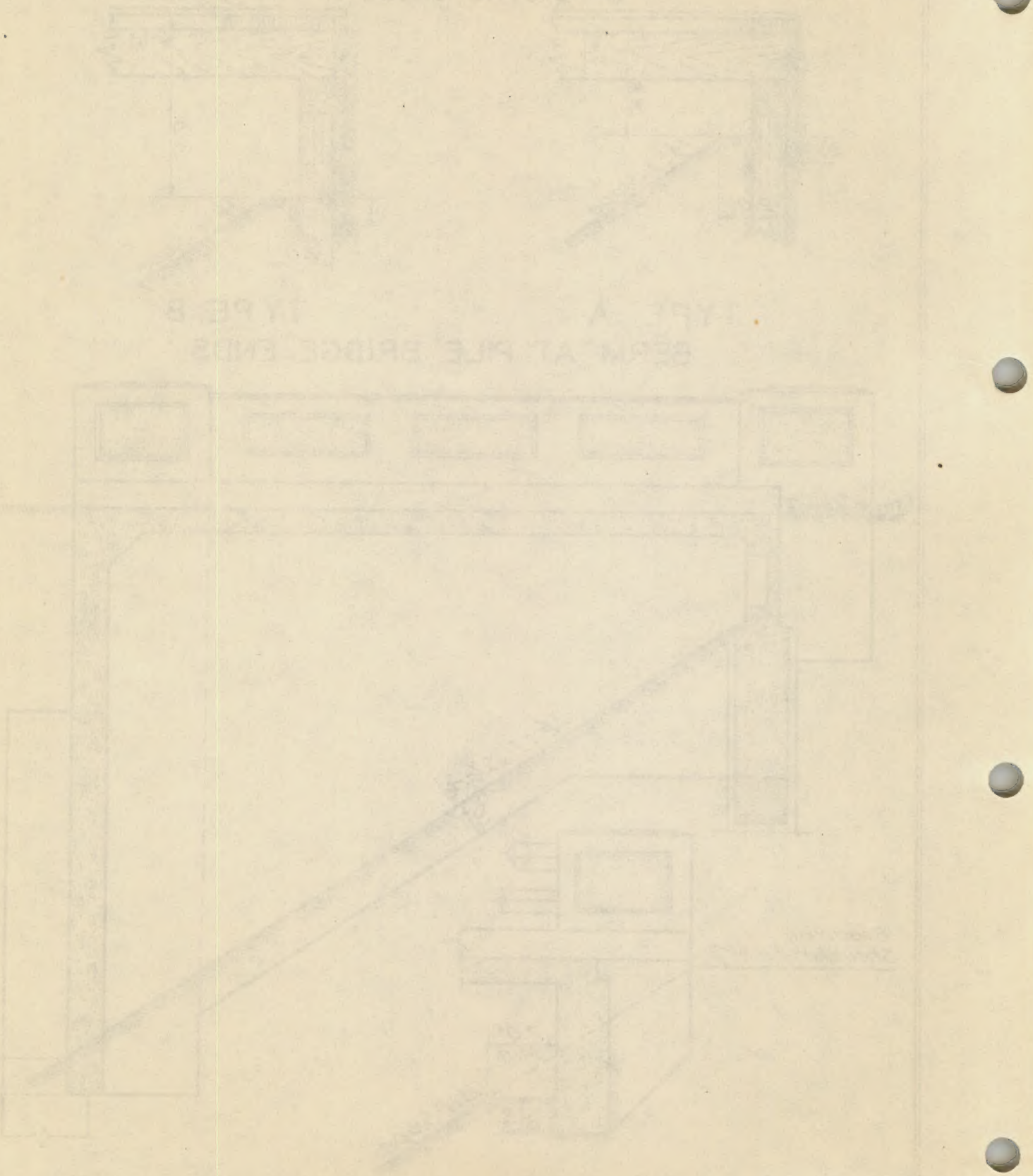
Montana State Highway Commission.



CONVENTIONAL SIGNS

PRIMARY ROADS .08 INCH WIDE
ALL OTHERS .05 INCH WIDE

PRIMITIVE ROADS

UNIMPROVED ROADS

GRADED ROAD

GRAVELED ROAD

OILED ROAD

PAVED ROAD (BRICK OR CONC.)

FED. AID ROUTING (NON-EXISTENT ROAD).

FED. AID ROUTING (ON EXISTING ROAD)

HIGHWAY BRIDGE (OVER 20' CLEAR SPAN).
W = WOOD, S = STEEL, C = CONCRETE (ABOVE)
T = TRUSS, G = GIRDER (BELOW).

DRAWBRIDGES

ARCHBRIDGES

FREE FERRIES

TOLL FERRIES

HIGHWAY TUNNELS

PASS

PIPESTONE PASS
ELEV. 6348

U.S. HIGHWAYS

STATE HIGHWAYS

FED. AID SYSTEM F.A.

FED. AID SECONDARY SYSTEM. F.A.S.

DAM WITH ROAD

DAM WITHOUT ROAD

RAILROAD (LARGE SCALE MAPS).

RAILROAD (SMALL SCALE MAPS).

RAILROAD STATIONS

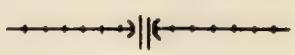
Montana State Highway Commission

APPROVED JUN. 1, 1946
R. H. Willcomb
ADMINISTRATIVE AID

CONVENTIONAL SIGNS

RAILROAD CROSSING

RAILROAD ABOVE

RAILROAD BELOW 

PRIVATELY OWNED RAILROAD

CATTLE GUARDS

FOR RAILROAD CROSSING PROTECTION

SIGNS (PLAIN)

SIGNS (REFLECTOR).

BELLS

LIGHTS (STATIONARY).

LIGHTS (FLASHING)

LIGHTS (STOP & GO).

WIG WAG

WATCHMAN

GATES (NOT CLASSIFIED)

GATES (MANUAL)

GATES (AUTOMATIC).

BARRIERS (MANUAL)

BARRIERS (AUTOMATIC).

APPROACH WARNING SIGNS (PLAIN)

APPROACH WARNING SIGNS (REFLECTOR).

STATE & NATIONAL LINE

COUNTY LINE

CITY, VILLAGE OR BOROUGH LINE

APPROVED JUN. 1, 1946.
T. A. Willcomb
ADMINISTRATIVE AID.

Montana State Highway Commission

CONVENTIONAL SIGNS

Used on Hwy. Plan Sheets.

- TOWNSHIP LINE
- SECTION LINE (Showing Corner) Solid, if found. Open, if not found — ¼ Cor.
- RESERVATION LINE
- FENCE LINE — Gate
- RAIL FENCE
- GUARD RAIL — Give Sta.
- GUIDE POSTS — Give Sta.
- SNOW FENCE — Give Sta.
- UNFENCED PROPERTY
- R/W LINE
- R/W LINE (FENCED) — R/W
- R.R. R/W (FENCED) — R.R. R/W
- R.R. R/W (UNFENCED) — R.R. R/W
- BASE OR SURVEY LINE — P.C. Sta. — N. 83° 40' E
- ℄ OF STAKED LINE WHEN A PROJ. IS MADE — STAKED N. 83°40'E
- TRAVELED WAY
- LEVEE
- RETAINING WALL — Give Sta.
- CULVERTS IN PLACE — with hdwl. — without hdwl.
- NEW CULVERTS (PLAN)
- NEW CULVERTS (PROFILE). — Flow line at ℄
- TROLLEY POLE — Give pole numbers
- POWER POLE
- TELEPHONE POLE

APPROVED JUN. 1, 1946
P.M. Williams
ADMINISTRATIVE AID

Montana State Highway Commission.

CONVENTIONAL SIGNS

TELEGRAPH POLE

GUY POLE

MARSH, SWAMP

DITCH (Kind)

RIPRAP (Give Sta.)

IRR. SYPHON Plan Profile F.l. of ℄

DROP INLET OR CATCH BASIN

CONC. BOX CULVERT Plan Profile F.l. of ℄

MANHOLE

HYDRANT

WELL

SCALES

STONE WALL

FOOT PATH (Give Sta. of new)

CONC. SIDEWALK (Give Sta. of new)

CONC. CURB New (Give Sta. of new) In place

HEDGE

HEAVY TIMBER, WOODS

SEPARATE TREES

ORCHARD

SPRING

INTERMITTENT STREAM

SMALL CREEK Ten Mile Creek

IRRIGATION CANAL Name

Montana State Highway Commission

APPROVED JUN. 1, 1946
P.M. Hillcoat
ADMINISTRATIVE AID

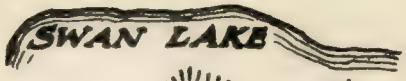
CONVENTIONAL SIGNS

LARGE CREEKS, SMALL RIVERS

LARGE RIVERS

Note: Shading for large rivers to be in pencil on the reverse side of the tracing.

LAKE



BLUFFS OR CLIFFS

GULCH

GRAVEL PIT.

AIR ROUTE

CIVIL AERONAUTICS AUTHORITY INTERMEDIATE AIR FIELD

COMMERCIAL OR MUNICIPAL AIR FIELD

MARKED AUXILIARY AIR FIELD

LETTER 'B' INDICATES HOUSING FACILITIES

GOLF GROUND OR COUNTRY CLUB

FAIR GROUNDS

CEMETERY

INCORPORATED TOWN

STATE CAPITAL

COUNTY SEAT

OTHER TOWNS

FARM UNIT

DWELLING

GROUPS OF DWELLINGS

SMALL BUSINESS ESTABLISHMENT

GROUP OF SMALL BUSINESS ESTABLISHMENTS

TOWN HALL

APPROVED JUN. 1, 1946
S. A. Hillcoat
ADMINISTRATIVE AID

Montana State Highway Commission

CONVENTIONAL SIGNS

CHURCH

SCHOOLHOUSE

CORRECTIONAL INSTITUTION

INDUSTRIAL PLANT

BEET DUMP

CAMP OR LODGE

RANGER OR GUARD STATION

LOOKOUT STATION

SAWMILL

CAMPGROUND

SEASONAL OR SUMMER COLONY DWELLING

GROUP OF SEASONAL OR SUMMER COLONY DWELLING

MINE , QUARRY OR OPEN CUT

OIL OR GAS WELL

TANKS

POWER PLANT

FORT

RADIO STATION

GARBAGE DUMP

STATE ROAD GARAGE

GAME FARM OR FISH HATCHERY

U.S. PORTS OF ENTRY

STATE COURTESY STATION

STATE COURTESY STATION WITH PIT SCALES

APPROVED JUN. 1, 1946
R.H. Willcomb
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Montana State Highway Commission

CONVENTIONAL SIGNS

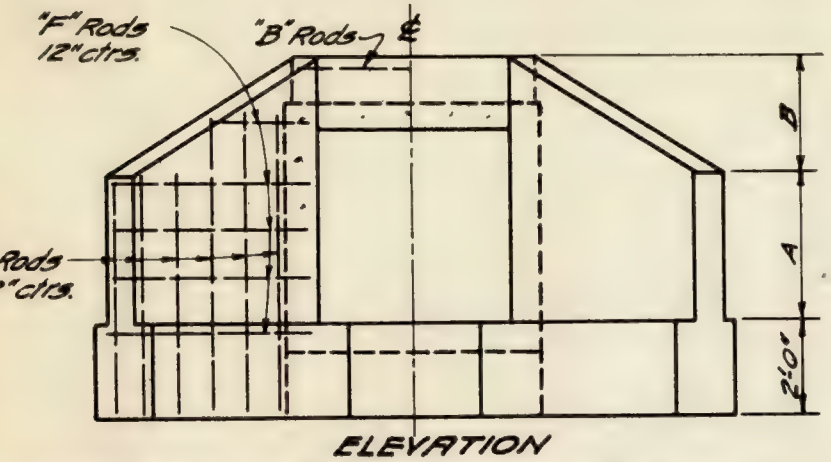
C.C.C. CAMP	CCC
GAUGING OR PUMPING STATION	
PROMINENT PEAK	Granite 12,850
GLACIER	
RESERVOIR WITH DAM	
PROJECT MARKER	
STATION MARKER	
R/W MONUMENT	
IRON PIN, IRON PIPE OR HUB & TACK.	• I.P. or H.T.
LIGHT CABLE	--L.C.-----L.C.---
TELEPHONE OR TELEGRAPH CABLE	--TELEPHONE-OR-TELEG.--
WATER LINE	---W-------W.---
SEWER LINE	--S-------S----
NATURAL GAS LINE	--N.G.-------N.G.---
GASOLINE OR OIL LINE	--GASOLINE OR OIL --

Montana State Highway Commission

APPROVED JUN. 1, 1946
D.W. Wilcomb
ADMINISTRATIVE AID

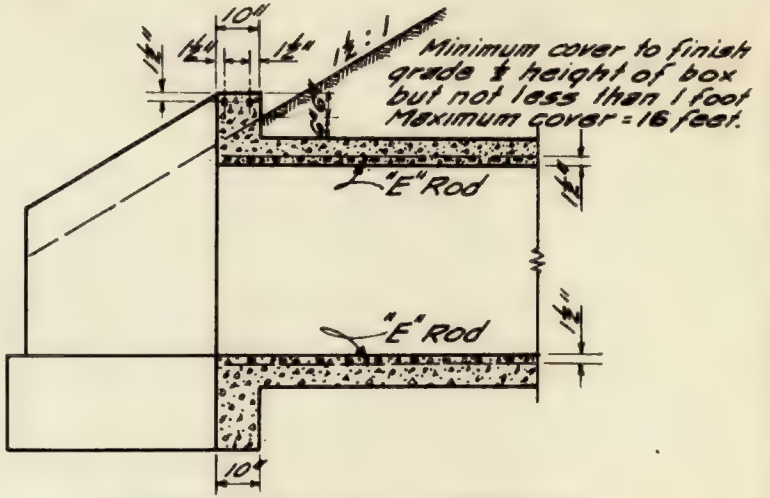
REV. 4-1-48

REINFORCED CONCRETE CULVERTS

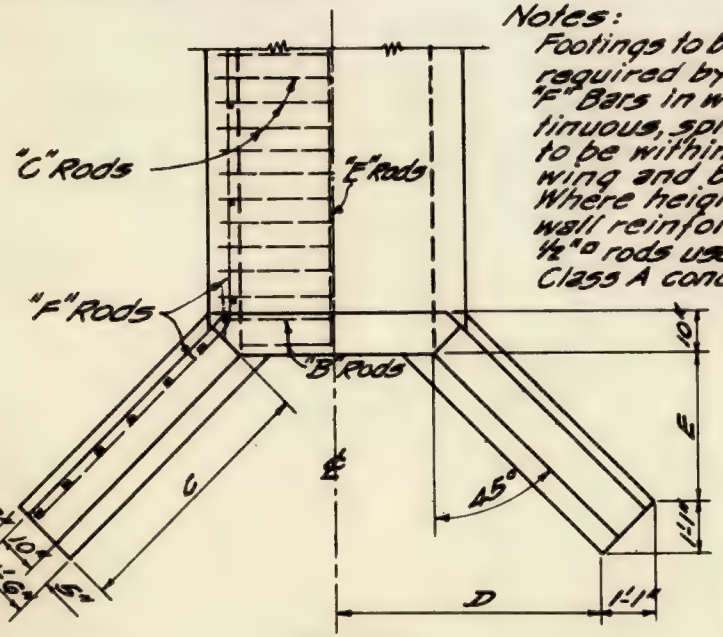


ELEVATION

Minimum length of culvert (out to out of headwall) = crown of roadway plus 4 feet.



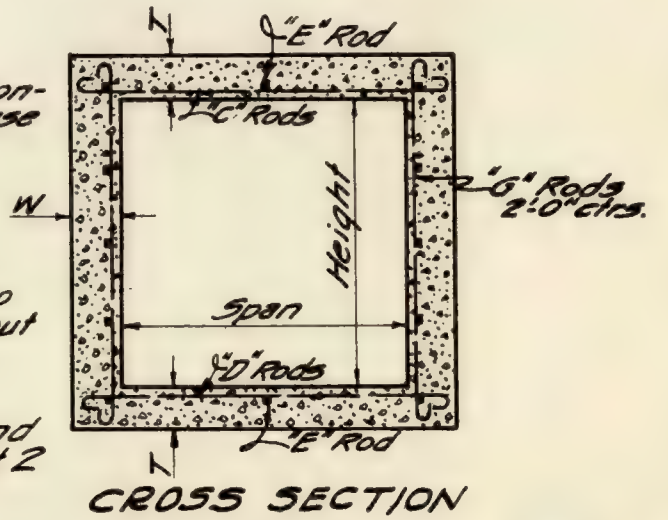
LONGITUDINAL SECTION



PLAN

Notes:
Footings to be carried deeper if required by the Engineer.
"F" Bars in wing and barrel to be continuous, splicing of bars in no case to be within 3'-0" of junction of wing and barrel.
Where height is 2'-0" or less, no wall reinforcing is to be used.
½" ø rods used throughout.
Class A concrete
All exposed corners to be chamfered throughout

For dimensions and quantities see Sheet 2



CROSS SECTION

NOTE:- Where box is specified to be lengthened see Std. sheet 18 LBC.

APPROVED JUN. 1, 1936
P. M. Williams
ADMINISTRATIVE AID

Montana State Highway Commission

REV. 5-1-48

11-C4

DIMENSIONS AND QUANTITIES
FOR REINFORCED CONCRETE BOX CULVERTS
WITH WING HEADWALLS

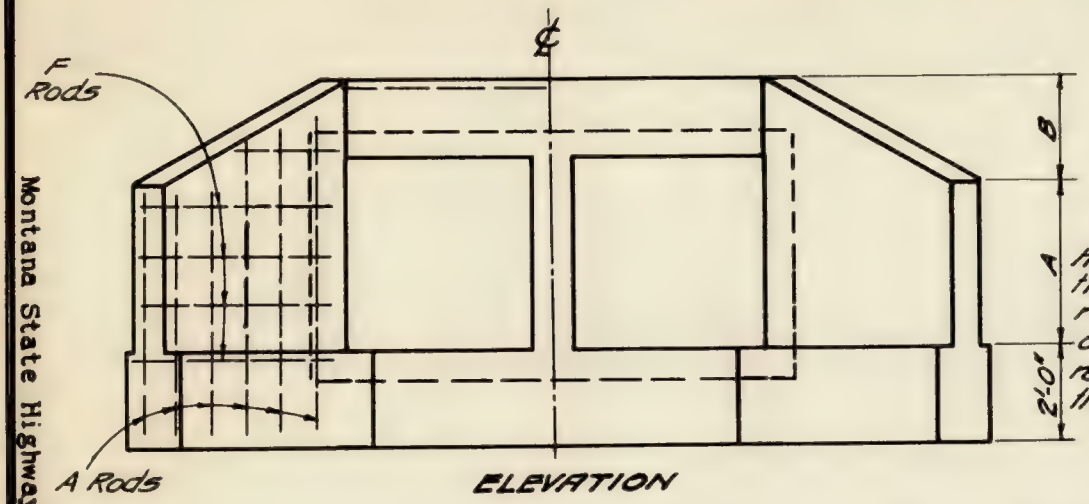
HEIGHT	SPAN	T	W	Headwall Dimensions A	B	C	D	E	BARS IN HEADWALL "A" RODS No.	Length	"B" RODS No.	Length	"E" RODS No.	Length	BARS IN BARREL "C" Rods No.	Length	"D" Rods No.	Length	"E" & "G" Rods No. Length Each End	CUYDS. CONC. IN 2 HOWLS	LBS. STEEL IN 2 HOWLS	Barrel per Lin. Ft. CUYDS. CONC.	LBS. STEEL
1'-6"	2'-0"	6"	6"	1'-9"	1'-3"	2'-6"	2'-3½"	1'-0⅜"	6	3'-6"	2	2'-6"	2	2'-0"	2	2'-9½"	2	2'-9"	0	2.54	395	.167	10.8
1'-6"	3'-0"	6	6	1'-9"	1'-3"	2'-6"	2'-11½"	1'-0⅜"	6	3'-6"	2	3'-6"	2	2'-0"	2	3'-9½"	2	3'-9"	0	2.76	62.9	.204	13.3
1'-6"	4'-0"	7	6	1'-9"	1'-4"	2'-8"	3'-7⅝"	1'-1⅝"	6	3'-6"	2	4'-6"	2	2'-0"	2	4'-9½"	2	4'-9"	0	3.14	66.9	.271	16.7
1'-6"	5'-0"	8	6	1'-9"	1'-5"	2'-10"	4'-2⅝"	1'-2⅝"	6	3'-6"	2	5'-6"	2	2'-0"	2	5'-9½"	2	5'-9"	0	3.52	70.8	.352	21.1
1'-6"	6'-0"	9	6	1'-9"	1'-6"	3'-0"	4'-10"	1'-4⅜"	6	3'-6"	2	6'-6"	2	2'-0"	2	6'-9½"	2	6'-9"	0	3.92	74.8	.444	27.2
2'-0"	2'-0"	6	6	2'-0"	1'-6"	3'-0"	2'-10"	1'-4⅜"	8	4'-0"	2	2'-6"	2	2'-0"	2	2'-9½"	2	2'-9"	0	3.07	91.8	.185	10.8
2'-0"	3'-0"	6	6	2'-0"	1'-6"	3'-0"	3'-4"	1'-4⅜"	8	4'-0"	2	3'-6"	2	2'-0"	2	3'-9½"	2	3'-9"	0	3.29	95.2	.222	13.3
2'-0"	4'-0"	7	6	2'-0"	1'-7"	3'-2"	3'-11½"	1'-5⅜"	8	4'-0"	2	4'-6"	2	2'-0"	2	4'-9½"	2	4'-9"	0	3.67	99.7	.290	16.7
2'-0"	5'-0"	8	6	2'-0"	1'-8"	3'-4"	4'-6⅝"	1'-7⅜"	8	4'-0"	2	5'-6"	2	2'-0"	2	5'-9½"	2	5'-9"	0	4.07	104.3	.370	21.1
2'-0"	6'-0"	9	6	2'-0"	1'-9"	3'-6"	5'-2⅛"	1'-8⅝"	8	4'-0"	2	6'-6"	2	2'-0"	2	6'-9½"	2	6'-9"	0	4.40	108.9	.463	27.2
3'-0"	3'-0"	6	6	3'-0"	2'-0"	3'-6"	3'-0"	1'-5⅝"	6	4'-6"	2	3'-6"	2	2'-6"	2	3'-11½"	2	3'-11"	0	4.48	144.5	.284	20.5
3'-0"	4'-0"	7	7	3'-0"	2'-1"	4'-2"	4'-0"	1'-7⅝"	6	4'-6"	2	4'-6"	2	2'-6"	2	4'-11½"	2	4'-11"	0	4.99	149.6	.353	24.1
3'-0"	5'-0"	8	7	3'-0"	2'-2"	4'-4"	5'-1⅜"	1'-8⅝"	6	4'-6"	2	5'-6"	2	2'-6"	2	5'-11½"	2	5'-11"	0	5.31	154.7	.434	30.5
3'-0"	6'-0"	9	7	3'-0"	2'-3"	4'-6"	5'-10⅝"	1'-9⅝"	6	4'-6"	2	6'-6"	2	2'-6"	2	6'-11½"	2	6'-11"	0	5.74	159.8	.528	36.8
3'-0"	7'-0"	10	7	3'-0"	2'-4"	4'-8"	6'-6⅝"	1'-10⅝"	6	4'-6"	2	7'-6"	2	2'-6"	2	7'-11½"	2	7'-11"	0	6.20	164.9	.634	47.4
3'-0"	8'-0"	11	7	3'-0"	2'-5"	4'-10"	7'-2⅝"	1'-11⅝"	6	4'-6"	2	8'-6"	2	2'-6"	2	8'-11½"	2	8'-11"	0	6.65	170.0	.752	61.0
4'-0"	4'-0"	7	8	3'-0"	2'-7"	5'-2"	5'-4⅝"	2'-0⅝"	6	6'-0"	2	4'-6"	2	3'-2"	2	5'-1"	2	5'-1"	0	6.32	206.3	.428	27.2
4'-0"	5'-0"	8	8	3'-0"	2'-8"	5'-4"	6'-1⅜"	2'-0⅝"	6	6'-0"	2	5'-6"	2	3'-2"	2	6'-1"	2	6'-1"	0	6.76	211.9	.510	33.6
4'-0"	6'-0"	9	8	3'-0"	2'-9"	5'-6"	6'-7⅝"	2'-1⅝"	6	6'-0"	2	6'-6"	2	3'-2"	2	7'-1"	2	7'-1"	0	7.22	217.6	.605	40.0
4'-0"	7'-0"	10	8	3'-0"	2'-10"	5'-8"	7'-2⅝"	2'-2⅝"	6	6'-0"	2	7'-6"	2	3'-2"	2	8'-1"	2	8'-1"	0	7.68	223.3	.712	47.2
4'-0"	8'-0"	11	8	3'-0"	2'-11"	5'-10"	7'-10⅝"	2'-3⅝"	6	6'-0"	2	8'-6"	2	3'-2"	2	9'-1"	2	9'-1"	0	8.16	229.9	.891	64.5
5'-0"	5'-0"	8	9	3'-6"	3'-2"	6'-4"	6'-0⅝"	2'-3⅝"	6	6'-6"	2	5'-6"	2	3'-10"	2	6'-3"	2	6'-3"	0	8.41	276.0	.599	36.7
5'-0"	6'-0"	9	9	3'-6"	3'-3"	6'-6"	7'-1⅜"	2'-4⅝"	6	6'-6"	2	6'-6"	2	3'-10"	2	7'-3⅜"	2	7'-3"	0	8.89	282.2	.694	43.2
5'-0"	7'-0"	10	9	3'-6"	3'-4"	6'-8"	7'-11⅝"	2'-5⅝"	6	6'-6"	2	7'-6"	2	3'-10"	2	8'-3⅜"	2	8'-3"	0	9.37	288.4	.802	54.0
5'-0"	8'-0"	11	9	3'-6"	3'-5"	6'-10"	8'-6⅝"	2'-6⅝"	6	6'-6"	2	8'-6"	2	3'-10"	2	9'-3⅜"	2	9'-3"	0	9.86	294.7	.923	67.9
6'-0"	4'-0"	7	10	4'-0"	3'-7"	7'-2"	6'-9½"	2'-4⅝"	8	7'-0"	2	4'-6"	2	4'-2"	2	5'-5⅜"	2	5'-5"	0	9.76	346.8	.615	33.3
6'-0"	5'-0"	8	10	4'-0"	3'-8"	7'-4"	7'-4½"	2'-5⅝"	8	7'-0"	2	5'-6"	2	4'-2"	2	6'-6⅜"	2	6'-6"	0	10.25	353.6	.700	39.8
6'-0"	6'-0"	9	10	4'-0"	3'-9"	7'-6"	8'-0⅝"	2'-6⅝"	8	7'-0"	2	6'-6"	2	4'-2"	2	7'-6⅜"	2	7'-6"	0	10.75	360.4	.797	46.4
6'-0"	7'-0"	10	10	4'-0"	3'-10"	7'-8"	8'-7½"	2'-7⅝"	8	7'-0"	2	7'-6"	2	4'-2"	2	8'-5⅜"	2	8'-5"	0	11.25	367.2	.905	57.3
6'-0"	8'-0"	11	10	4'-0"	3'-11"	7'-10"	9'-2½"	2'-8⅝"	8	7'-0"	2	8'-6"	2	4'-2"	2	9'-5⅜"	2	9'-5"	0	11.64	374.0	1.027	71.4
7'-0"	6'-0"	9	11	4'-6"	4'-3"	9'-0"	9'-1"	2'-5¾"	10	6'-6"	2	6'-6"	2	4'-2"	2	6'-6⅜"	2	6'-6"	0	12.46	504.0	.910	49.1
7'-0"	7'-0"	10	11	4'-6"	4'-4"	9'-2"	9'-11½"	2'-6¾"	10	6'-6"	2	7'-6"	2	4'-2"	2	7'-6⅜"	2	7'-6"	0	13.20	512.8	1.027	56.0
7'-0"	8'-0"	11	11	4'-6"	4'-5"	9'-4"	10'-9½"	2'-7¾"	10	6'-6"	2	8'-6"	2	4'-2"	2	8'-7⅜"	2	8'-7"	0	13.94	521.6	1.144	62.9

Note-Subtract 10" from Length of barrel for each headwall and multiply by cu. yds. and lbs. per foot.
Quantities for Estimating purposes only.

Montana State Highway Commission

APPROVED JUN. 1, 1946
P. St. Villecomb
ADMINISTRATIVE AID

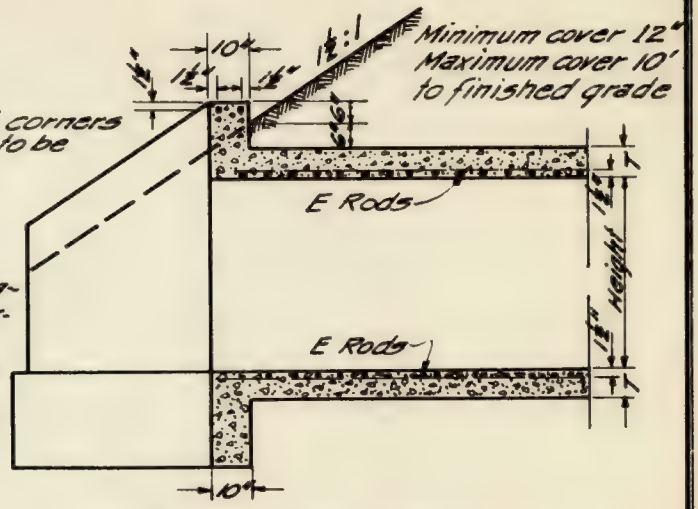
REINFORCED CONCRETE DOUBLE BOX CULVERT



ELEVATION

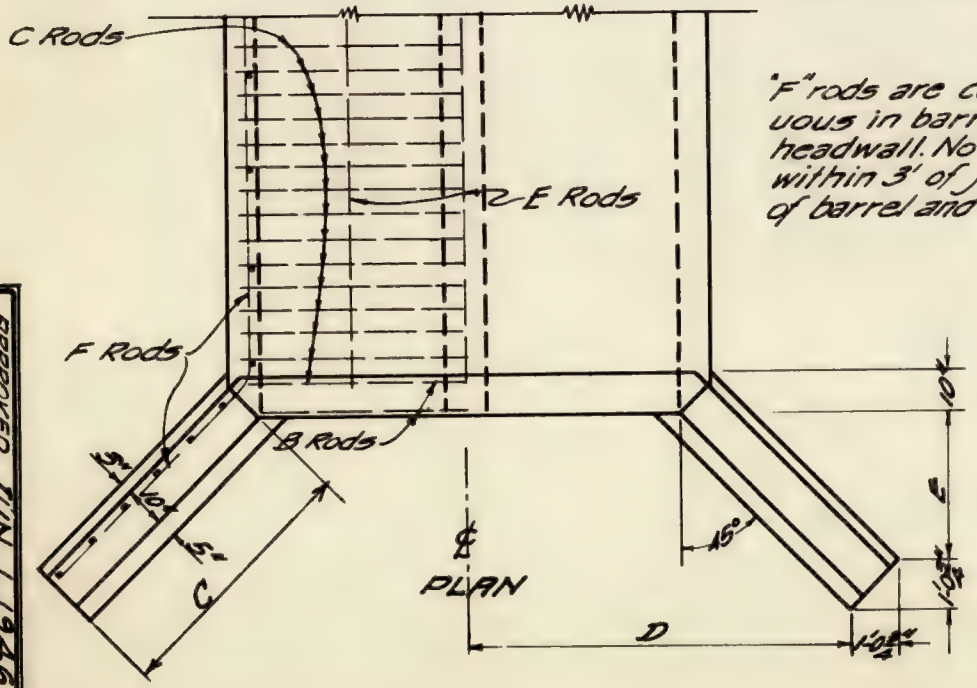
All exposed corners of concrete to be chamfered.

Note:
Headwall foundations to be carried deeper or spread as required by the Engineer



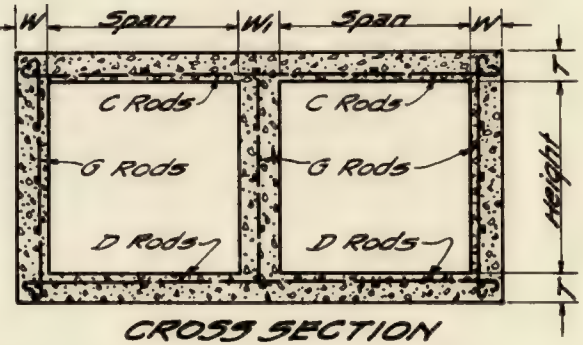
LONGITUDINAL SECTION

NOTE:- LENGTHENING – See Std. 18 LBC



PLAN

"F" rods are continuous in barrel and headwall. No splices within 3' of junction of barrel and headwall



CROSS SECTION

Note:
Minimum length of Culvert (out to out of headwalls) = Crown of roadway, plus 4 feet.

Class A concrete.

½"□ rods throughout.

For dimensions and quantities see Std. C4a2.

Montana State Highway Commission.

APPROVED JUN. 1, 1946
Chas. H. Swingle
ADMINISTRATIVE AID

REV. 5-1-48

13-C4a.

DIMENSIONS AND QUANTITIES FOR REINFORCED CONCRETE DOUBLE BOX CULVERTS WITH WING HEADWALLS

HEIGHT	SPAN	W	W1	T	A	B	C	D	E	BARS IN HEADWALLS A 12" ctr. No.	A Lgth.	B No.	B Lgth.	F 12" ctr. No.	F Lgth.	G No.	G Lgth.	BARS IN BARREL C Spacing	C Lgth.	D Spacing	D Lgth.	E No. 24"c	F No. 12"c	G Lgth. 24"c	1 HEADWALL CONC. YDS.	1 HEADWALL STEEL LBS.	2 HEADWALLS CONC. YDS.	2 HEADWALLS STEEL LBS.	BARREL PER LIN. FT. CONC. YDS.	BARREL PER LIN. FT. STEEL LBS.
2'-0"	4'-0"	6"	9"	7"	2'-0"	1'-7"	3'-2"	6'-4"	1'-5⅝"	8	4'-0"	2	9'-0"	4	3'-2"	1	5'-4"	7	9'-6"	10	9'-6	7	6	0	2.41	62.1	4.82	124.1	0.548	33.94
2'-0	5'-0	6	9	8	2'-0	1'-8	3'-4	7'-5½	1'-7⅛	8	4'-0	2	11'-0	4	3'-4	1	5'-4	6	11'-6	9	11'-6	11	6	0	2.73	66.0	5.47	132.0	0.709	47.48
2'-0	6'-0	6	9	9	2'-0	1'-9	3'-6	8'-6¾	1'-8⅝	8	4'-0	2	13'-0	4	3'-6	1	5'-4	5	13'-6	8	13'-6	11	6	0	3.07	70.0	6.14	140.0	0.894	58.78
3'-0	3'-0	7	9	6	2'-6	2'-0	4'-0	5'-11	2'-0⅛	6	4'-6"	2	7'-0"	6	4'-0"	1	6'-3"	8	7'-8"	11	7'-8"	7	8	3'-9"	2.72	83.5	5.43	167.0	0.507	34.35
3'-0	4'-0	7	9	7	2'-6	2'-1	4'-2	7'-0½	2'-2⅜	6	4'-6	2	9'-0	6	4'-2	1	6'-3	7	9'-8	10	9'-8	7	8	3'-11	3.04	87.8	6.08	175.5	0.643	41.42
3'-0	5'-0	7	9	8	2'-6	2'-2	4'-4	8'-1½	2'-3⅝	6	4'-6	2	11'-0	6	4'-4	1	6'-3	6	11'-8	9	11'-8	11	8	4'-1	3.37	92.0	6.75	184.0	0.800	54.32
3'-0	6'-0	7	9	9	2'-6	2'-3	4'-6	9'-3¼	2'-5⅛	6	4'-6	2	13'-0	6	4'-6	1	6'-3	5	13'-8	8	13'-8	11	8	4'-3	3.72	96.3	7.44	192.5	0.987	66.87
3'-0	7'-0	7	9	10	2'-6	2'-4	4'-8	10'-4⅝	2'-6½	6	4'-6	2	15'-0	6	4'-8	1	6'-3	4	15'-8	7	15'-8	15	8	4'-5	4.08	100.5	8.16	201.0	1.195	87.21
3'-0	8'-0	7	9	11	2'-6	2'-5	4'-10	11'-6	2'-7⅞	6	4'-6	2	17'-0	6	4'-10	1	6'-3	3	17'-8	6	17'-8	15	8	4'-7	4.45	104.8	8.90	209.5	1.430	114.77
4'-0	4'-0	8	10	7	3'-0	2'-7	5'-2	7'-9⅜	2'-0¼	6	5'-0"	2	9'-1"	8	5'-2"	1	7'-4"	7	9'-9"	10	9'-9"	7	10	4'-11"	3.78	117.2	7.56	234.3	0.762	44.71
4'-0	5'-0	8	10	8	3'-0	2'-8	5'-4	8'-10½	3'-0⅛	6	5'-0	2	11'-1	8	5'-4	1	7'-4	6	11'-9	9	11'-9	11	10	5'-1"	4.13	121.7	8.29	243.4	0.921	57.64
4'-0	6'-0	8	10	9	3'-0	2'-9	5'-6	10'-0⅝	3'-1½	6	5'-0	2	13'-1	8	5'-6	1	7'-4	5	13'-9	8	13'-9	11	10	5'-3	4.49	126.2	9.01	252.4	1.109	70.23
4'-0	7'-0	8	10	10	3'-0	2'-10	5'-8	11'-1½	3'-2⅞	6	5'-0	2	15'-1	8	5'-8	1	7'-4	4	15'-9	7	15'-9	15	10	5'-5	4.85	130.8	9.73	261.5	1.319	90.62
4'-0	8'-0	8	10	11	3'-0	2'-11	5'-10	12'-3	3'-4⅝	6	5'-0	2	17'-1	8	5'-10	1	7'-4	3	17'-9	6	17'-9	15	10	5'-7	5.23	135.3	10.50	270.6	1.554	118.62
5'-0	5'-0	9	12	8	3'-6	3'-2	6'-4	9'-0½	3'-8⅜	8	5'-6"	2	11'-3"	10	6'-4"	1	8'-5"	6	12'-3"	9	12'-3"	11	12	6'-1"	5.00	154.9	10.08	309.8	1.079	62.12
5'-0	6'-0	9	12	9	3'-6	3'-3	6'-6	10'-9⅝	3'-10	8	5'-6	2	13'-3	10	6'-6	1	8'-5	5	14'-3	8	14'-3	11	12	6'-3	5.37	159.7	10.82	319.5	1.269	74.95
5'-0	7'-0	9	12	10	3'-6	3'-4	6'-8	11'-11⅝	3'-11⅞	8	5'-6	2	15'-3	10	6'-8	1	8'-5	4	16'-3	7	16'-3	15	12	6'-5	5.75	164.5	11.57	329.1	1.483	95.67
5'-0	8'-0	9	12	11	3'-6	3'-5	6'-10	13'-0¼	4'-0⅞	8	5'-6	2	17'-3	10	6'-10	1	8'-5	3	18'-3	6	18'-3	15	12	6'-7	6.23	169.4	12.35	338.7	1.717	123.06
6'-0	6'-0	9	12	9	4'-0	3'-9	7'-6	11'-6⅞	4'-6½	8	6'-0"	2	13'-3"	12	7'-6"	1	9'-6"	5	14'-3"	8	14'-3"	12	14	7'-3"	6.31	199.8	12.74	399.5	1.361	78.90
6'-0	7'-0	9	12	10	4'-0	3'-10	7'-8	12'-7½	4'-7⅜	8	6'-0	2	15'-3	12	7'-8	1	9'-6	4	16'-3	7	16'-3	16	14	7'-5	6.67	204.9	13.51	409.7	1.576	99.62
6'-0	8'-0	9	12	11	4'-0	3'-11	7'-10	13'-8⅝	4'-8½	8	6'-0	2	17'-3	12	7'-10	1	9'-6	3	18'-3	6	18'-3	16	14	7'-7	7.10	210.0	14.29	419.9	1.815	127.82

NOTE:

ALL RODS ½" SQUARE
THEORETICAL WEIGHT = 0.85 LBS. PER FOOT
FOR ALL COMPUTATIONS
NO ALLOWANCE MADE FOR SPLICES
QUANTITIES ARE FOR ESTIMATING PURPOSES ONLY.

Montana State Highway Commission

APPROVED JUN. 1, 1946
R. A. Hilleque
ADMINISTRATIVE AID

14-C482

LIVE LOAD DISTRIBUTION ON FILLS UP TO AND INCLUDING 20 FT.

Transverse Spread E = 1.2 + 1.6 H, but not exceeding 2.6 + 0.8 H

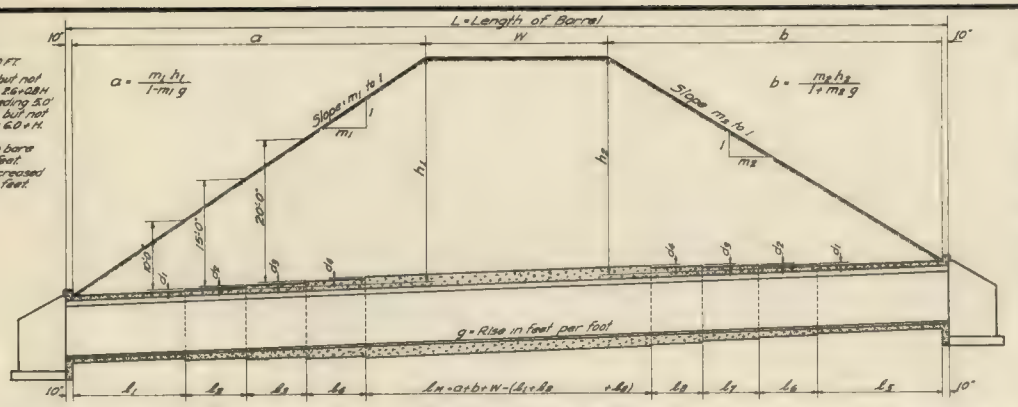
ℓ not exceeding 5.0'

Longitudinal Spread K = 1.3 + 1.5 H, but not exceeding 6.0 + H.

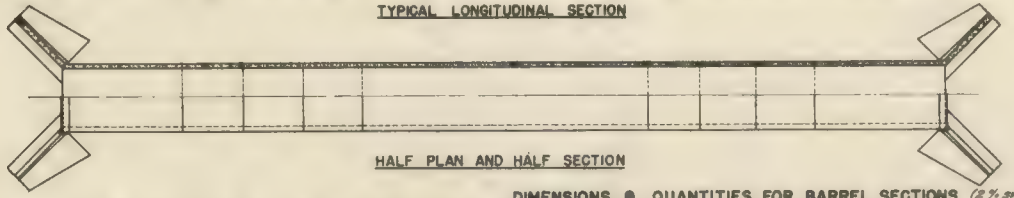
H = Height of fill.

Impact - Tapered from 30 % on bare slab to 0 % when H = 3 feet.

Stresses - Allowable stresses increased 30 % for fills over 10 feet.



TYPICAL LONGITUDINAL SECTION



HALF PLAN AND HALF SECTION

NOTE — Where maximum fill does not exceed 10 ft use same barrel section throughout. For greater fill step culvert barrel as necessary, as shown in Typical Longitudinal Section, each succeeding section being good for 5 ft greater depth of fill. The lengths of the various sections may be determined by the following formulas.

$\ell_1 = \frac{100\,m_1}{1 - m_1 g}$ $\quad \ell_5 = \frac{100\,m_2}{1 + m_2 g}$

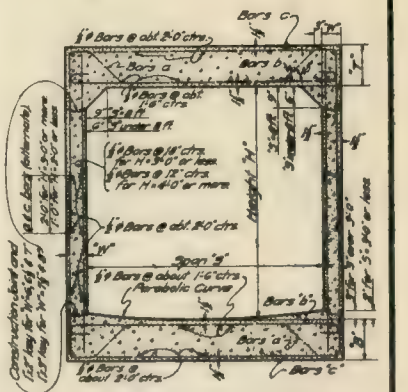
$\ell_2 = \frac{(50 + d_1)\,m_1}{1 - m_1 g}$ $\quad \ell_6 = \frac{(50 + d_6)\,m_2}{1 + m_2 g}$

$\ell_3 = \frac{(50 + d_2)\,m_1}{1 - m_1 g}$ $\quad \ell_7 = \frac{(50 + d_7)\,m_2}{1 + m_2 g}$

$\ell_4 = \frac{(50 + d_3)\,m_1}{1 - m_1 g}$ $\quad \ell_8 = \frac{(50 + d_8)\,m_2}{1 + m_2 g}$

Calculate lengths of additional sections, when required, similarly.

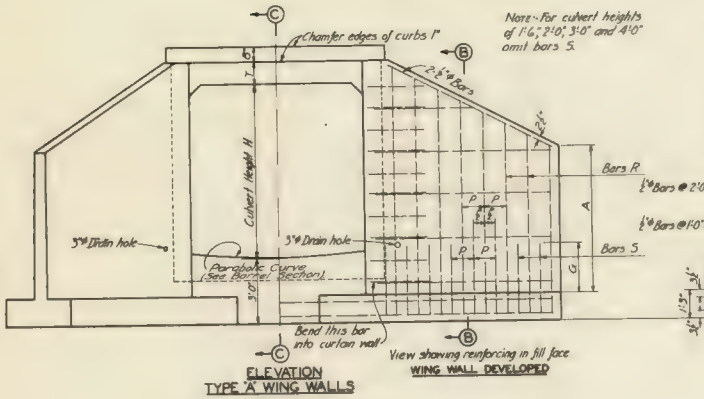
For skewed culverts make all dimensions and reinforcing details of wing walls and footings the same as for square ends, excepting as they are modified by the skew angle and the lengths of the wing walls. See Diagram for lengths of Wing Walls on Dwg No. S-11.



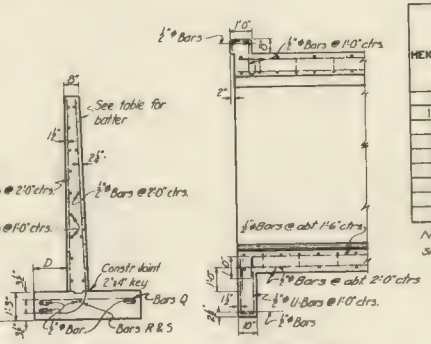
TYPICAL SECTION OF BARREL

DIMENSIONS & QUANTITIES FOR BARREL SECTIONS (2 % small added to reinforcing quantities)

| CLEAR SPAN | DAY HEIGHT "H" | FILLS UNDER 3 FT. | | | | | | | | | | FILLS 3+ to 10 FT. | | | | | | | | | | FILLS 10+ to 15 FT | | | | | | | | | | FILLS 15+ to 20 FT. | | | | | | | | | | FILLS 20+ to 25 FT. | | | | | | | | | | FILLS 25+ to 30 FT. | | | | | | | | | | FILLS 30+ to 35 FT. | | | | | | | | | | FILLS 35+ to 40 FT. | | | | | | | | | |
|---|---|---


Chamfer edges of curbs 1"
2-¾"ø Bars
Culvert Height H
Bars R
Bars S
3"ø Drain hole
Parabolic Curve (See Barrel Section)
Bend this bar into curtain wall
Note:- For culvert heights of 1'-6", 2'-0", 3'-0" and 4'-0" omit bars S.

ELEVATION
TYPE "A" WING WALLS



SECTION B-B

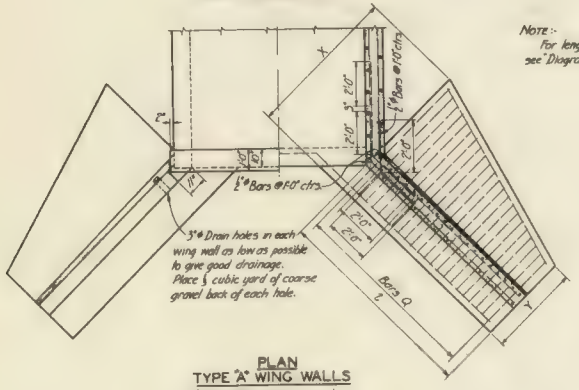
SECTION C-C

DIMENSIONS OF TYPE "A" WING WALLS											
HEIGHT	LENGTH WING WALL	BATTER	DISTANCE	DISTANCE	DISTANCE	BARS R & S		BARS Q		DISTANCE
						SIZE	SPACING	SIZE	SPACING	
H	ℓ		A	X	Y	D				G
1'-6"	2'-1"	None	3'-4"	3'-0"	2'-3"	0'-9"	¾ø	12"	¾ø	12"	
2'	2'-8"	"	3'-8"	3'-4"	2'-5"	0'-10½"	¾ø	12"	¾ø	12"	
3'	4'-1"	"	4'-3"	3'-10"	2'-9"	0'-11½"	¾ø	12"	¾ø	12"	
4'	5'-1"	"	4'-9"	4'-4"	3'-1"	1'-1½"	¾ø	8"	¾ø	12"	
5'	6'-2"	"	5'-3"	5'-2"	3'-4½"	1'-3"	¾ø	11"	¾ø	8"	2'-6"
6'	7'-3"	1 in 12	5'-9"	5'-8"	3'-8"	1'-4"	¾ø	11"	¾ø	5½"	2'-6"
7'	8'-1"	1 in 12	6'-8"	6'-7"	3'-11"	1'-6"	¾ø	11"	¾ø	3½"	2'-6"
8'	9'-4"	1 in 12	6'-9"	6'-10½"	4'-4"	1'-6"	¾ø	12"	¾ø	5"	2'-9"

Note:- This table to be used for culverts that are not skewed for skewed culverts see diagram, Dwg No. S-11.

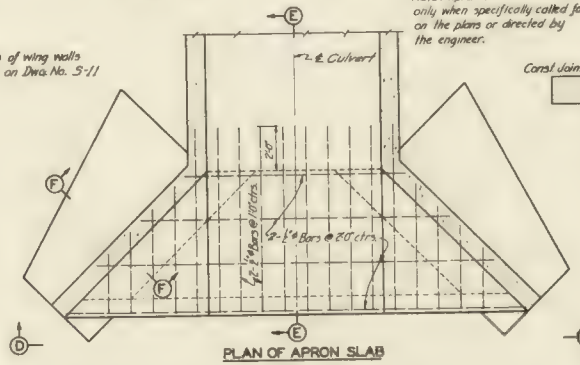
QUANTITIES IN WING WALLS (ONE END ONLY)					
CULVERT HEIGHT	CLEAR SPAN	TYPE "A"		TYPE "A" WITH APRON SLAB	
		CONC. CU.YDS.	REINF. STEEL LBS.*	CONC. CU.YDS.	REINF. STEEL LBS.*
1'6"	2'	1.20	136	1.53	154
2'		1.56	170	1.78	196
2'	3'	1.66	178	1.92	212
3'		2.68	271	3.26	326
2'	4'	1.76	189	2.08	226
3'		2.79	283	3.48	350
4'		3.76	375	4.74	457
3'	5'	2.81	292	3.62	370
4'		3.86	386	4.92	478
5'		5.06	485	6.48	599
3'	6'	2.96	301	3.80	389
4'		3.95	397	5.12	500
5'		5.15	495	6.69	617
6'		6.79	652	8.75	789
7'		8.10	932	10.37	1059
3'	8'	3.12	321	4.16	426
4'		4.11	419	5.51	541
5'		5.31	515	7.12	658
6'		6.97	672	8.86	832
8'		10.67	1173	13.85	1425

*2.7% swell added to reinforcing quantities.


¾"ø Bars @ 1'0" ctrs.
3"ø Drain holes in each wing wall as low as possible to give good drainage. Place ½ cubic yard of coarse gravel back of each hole.
Bars Q

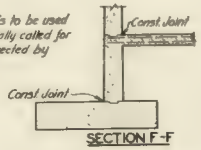
PLAN
TYPE "A" WING WALLS
(Wing walls making an angle with barrel)

Note:- For lengths of wing walls see "Diagram" on Dwg. No. S-11

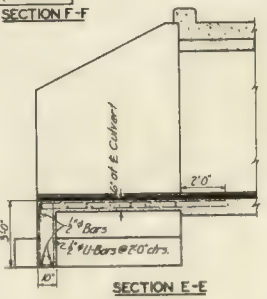


PLAN OF APRON SLAB

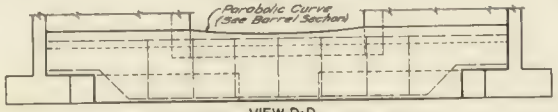
Note:- Apron Slab is to be used only when specifically called for on the plans or directed by the engineer.



SECTION F-F



SECTION E-E

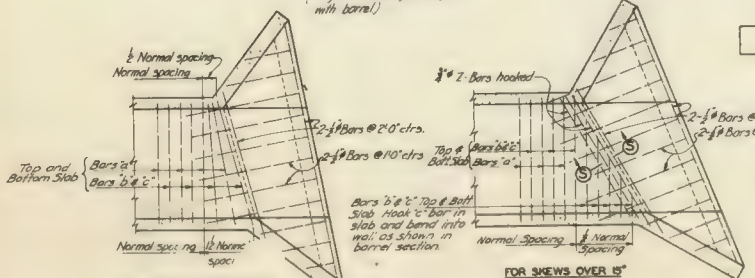


VIEW D-D
APRON SLAB FOR TYPE "A" WING WALLS

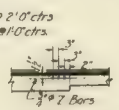
NOTES

QUANTITIES:- Quantities in wing walls tabulated are for one end of a square culvert and include:
For Type "A": Wing Walls and their footings, cut-off wall, and curb.
For Type "A" with Apron Slab: Wing walls and their footings, curb, apron slab and cut-off wall.
For skewed culverts these quantities must be computed.

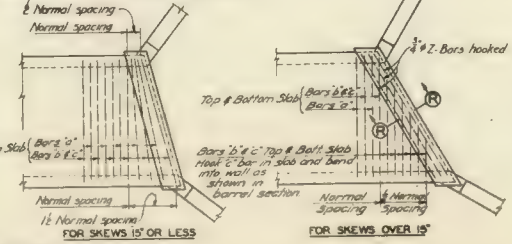
OTHER NOTES:- For other notes see Dwg. No. S-9.

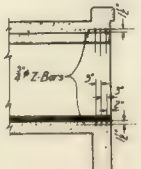

½ Normal spacing
Normal spacing
2-¾"ø Bars @ 2'-0" ctrs.
2-¾"ø Bars @ 1'-0" ctrs.
Top and Bottom Slab
Bars 'a'
Bars 'b' & 'c'
Normal spacing
½ Normal spacing
FOR SKEW 1° 15° OR LESS
¾"ø Z-Bars hooked
2-¾"ø Bars @ 2'-0" ctrs.
2-¾"ø Bars @ 1'-0" ctrs.
Top & Bott. Slab
Bars 'a'
Bars 'b' & 'c' Top & Bott. Slab Hook 'c' bar in slab and bend into wall as shown in barrel section
Normal Spacing
½ Normal Spacing
FOR SKEWS OVER 15°

BOTTOM SLAB WITH APRON



SECTION S-S


½ Normal spacing
Normal spacing
Top & Bottom Slab
Bars 'a'
Bars 'b' & 'c'
1½ Normal spacing
FOR SKEWS 15° OR LESS
¾"ø Z-Bars hooked
Top & Bottom Slab
Bars 'b' & 'c'
Bars 'a'
Bars 'b' & 'c' Top & Bott. Slab Hook 'c' bar in slab and bend into wall as shown in barrel section
Normal Spacing
½ Normal Spacing
FOR SKEWS OVER 15°



SECTION R-R

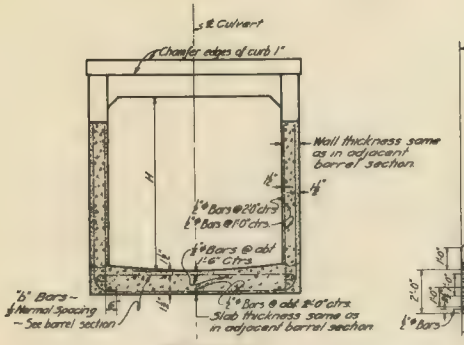
SLAB REINF. FOR SKEWED ENDS - TYPE A WING WALLS.

STATE OF MONTANA
STATE HIGHWAY COMMISSION
STANDARD REINFORCED CONCRETE BOX CULVERTS
SHEET № 2 OF 3 SHEETS
FOR OTHER DETAILS SEE DWGS. NO. S-9 AND S-11

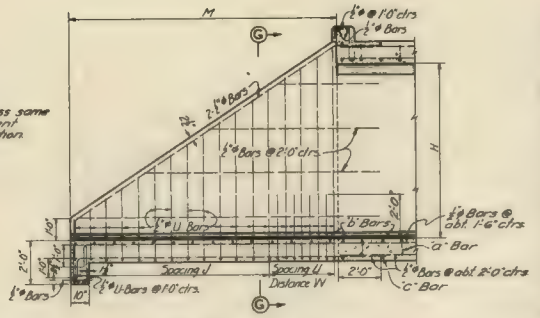
APPROVED BY S. H. Tr. BRIDGE PLANS ENGINEER

DRAWING NO. S-10

16 - S10


℄ Culvert
Chamfer edges of curb 1"
Wall thickness same as in adjacent barrel section
H
½"
¾"
#6 Bars @ 2'0" ctrs.
#6 Bars @ 1'0" ctrs.
#5 Bars @ abt 1'-6" Ctrs.
"b" Bars — ½ Normal Spacing — See barrel section
#6 Bars @ abt 2'-0" ctrs.
Slab thickness same as in adjacent barrel section

SECTION G-G

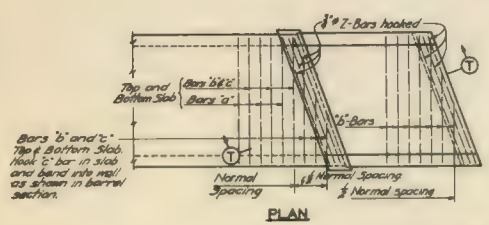


SECTION ALONG ℄ CULVERT
View showing reinforcing in fill face of wing wall

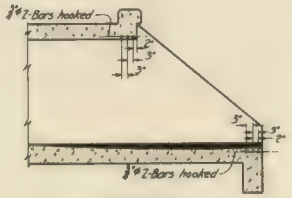
TYPE 'B' WING WALLS
(Wing walls parallel to barrel)

QUANTITIES IN WING WALLS ONE END ONLY					
CULVERT HEIGHT	CLEAR SPAN	TYPE 'B' FILLS UNDER 3 FT.		TYPE 'B' FILLS 3 to 10 FT.	
		CONC. CU.YDS.	REINF. STEEL LBS.*	CONC. CU.YDS.	REINF. STEEL LBS.*
1'-6"	2	0.43	93	0.43	93
2'		0.56	106	0.56	106
2'	3	0.69	127	0.69	127
3'		1.06	178	1.06	178
2'	4	0.83	144	0.85	144
3'		1.24	209	1.27	202
4'		1.63	284	1.68	277
3'	5	1.45	241	1.49	243
4'		1.90	319	1.95	321
5'		2.48	396	2.56	408
3'	6	1.71	263	1.76	289
4'		2.23	345	2.29	386
5'		2.81	425	2.88	472
6'		3.57	504	3.67	562
7'		4.36	636	4.45	694
3'	8	2.36	340	2.39	375
4'		3.07	407	3.31	477
5'		3.86	515	4.16	586
6'		4.72	642	5.09	682
8'		6.66	960	7.17	1030

* 2% Swell added to reinforcing quantities.


#6 Z-Bars hooked
Top and Bottom Slab
Bars "b" & "c"
Bars "a"
"b" Bars
Bars "b" and "c" Top & Bottom Slab. Hook "c" bar in slab and bend into wall as shown in barrel section.
Normal Spacing
½ Normal Spacing
Normal Spacing

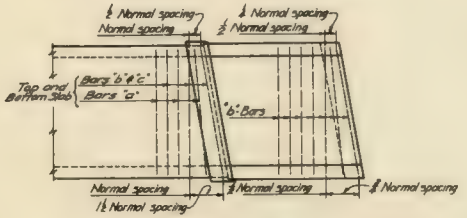
PLAN



SECTION T-T

DIMENSIONS OF TYPE "B" WING WALLS				
HEIGHT	LENGTH OF WING WALL	SPACING	SPACING	DISTANCE
H	M	J	U	W
1'-6"	1'-10"	12"		
2'	2'-9"	12"		
3'	4'-8"	12"		
4'	6'-2"	12"		
5'	7'-8"	12"	6"	1'-6"
6'	9'-2"	12"	6"	4'-6"
7'	10'-4"	10"	5"	2'-6"
8'	12'-2"	9"	4½"	3'-0"

FOR SKEWS OVER 15°



PLAN FOR SKEWS 15° OR LESS

SLAB REINF. FOR SKEWED ENDS-TYPE 'B' WING WALLS

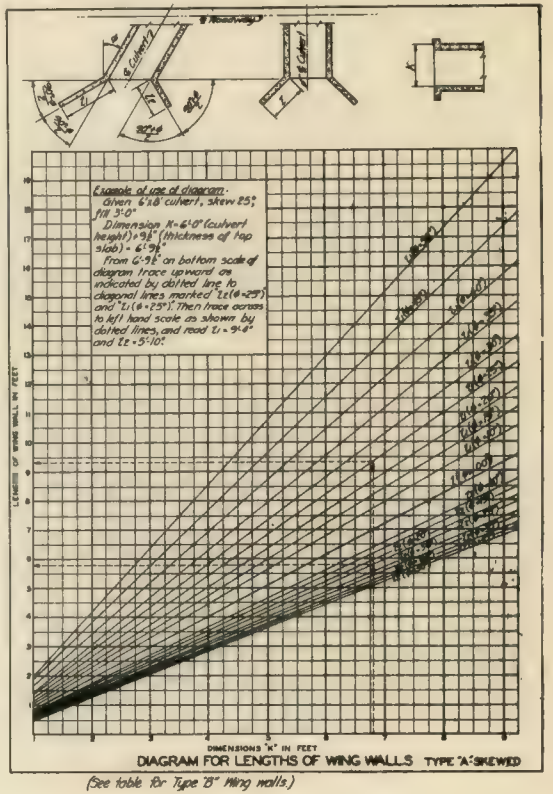

℄ Roadway
℄ Culvert
H
Example of use of diagram:
Given 6'x8' culvert, Skew 25°; Fill 5'-0"
Dimension H=6'-0" (culvert height) + 9½" (thickness of top slab) = 6'-9½"
From 6'-9½" on bottom scale of diagram trace upward as indicated by dotted line to diagonal lines marked "L(θ=25°)" and "L₁(θ=25°)". Then trace across to left hand scale as shown by dotted lines, and read L₁ = 9'-6" and L₂ = 5'-10"
LENGTH OF WING WALL IN FEET
DIMENSIONS "H" IN FEET

DIAGRAM FOR LENGTHS OF WING WALLS TYPE 'A' SKEWED

(See table for Type "B" Wing walls.)

-NOTES-

QUANTITIES:-
Quantities in wing walls tabulated are for one end of square culvert and include:
For Type 'B': Wing walls, bottom slab between them, cut-off wall and curb.
For skewed culverts: these quantities must be computed.

OTHER NOTES:-*For other notes see Drwg. No. S-9.*

STATE OF MONTANA
STATE HIGHWAY COMMISSION

STANDARD REINFORCED CONCRETE BOX CULVERTS

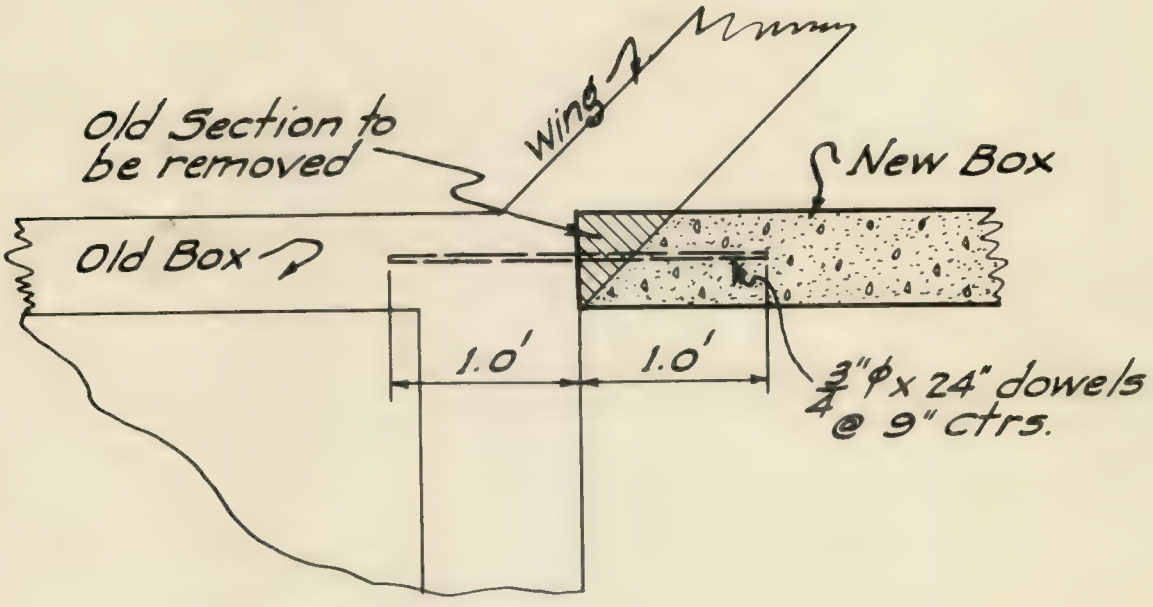
SHEET Nº 3 of 3 SHEETS
FOR OTHER DETAILS SEE DWGS. NO. S-9 & S-10

APPROVED BY ... BRIDGE PLANS ENGINEER

DRAWING NO. S-11

117 - 511

DETAIL FOR LENGTHENING EXISTING RE-CONC. BOX CULVERT.

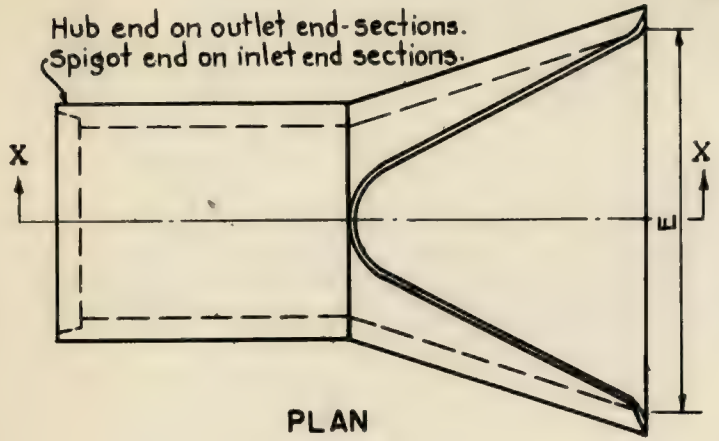


NOTE:- Doweling as shown to be used where top, sides and bottom of new box join that of the old. Curb to be removed if necessary.

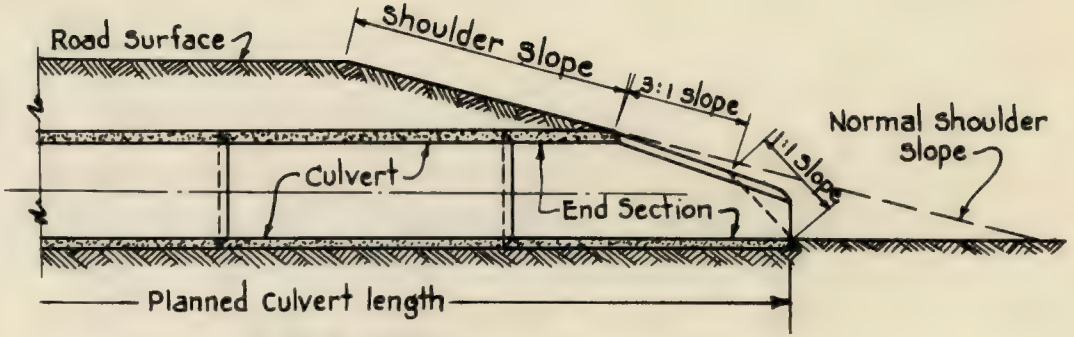
Montana State Highway Commission.

APPROVED JUN. 1, 1946
R. A. Hillcoat
ADMINISTRATIVE AID

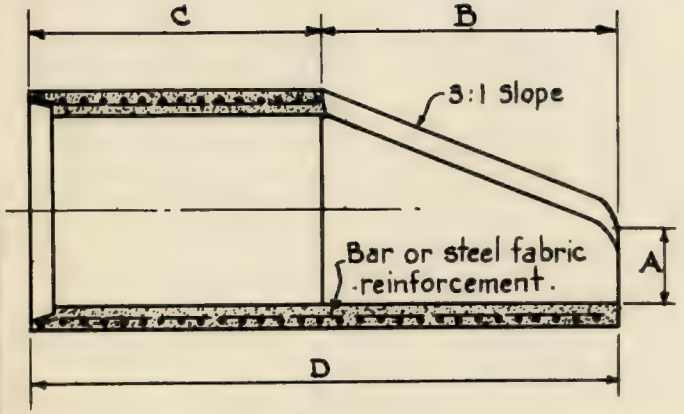
FLARED END TERMINAL SECTION
FOR REINFORCED SECTIONAL CONCRETE PIPE
(PREFABRICATED)



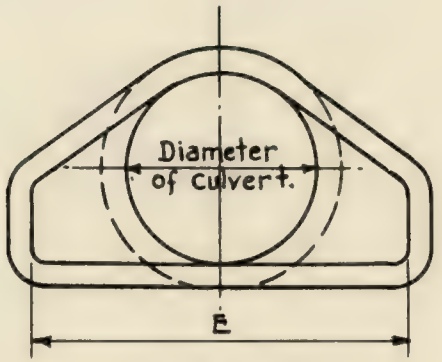
PLAN



SLOPE DETAIL



SECTION X-X



END VIEW

END-SECTION DIMENSIONS					
DIAM.	A	B	C	D	E
12"	4"	2'-0"	4'-0 7/8"	6'-0 7/8"	2'-0"
15"	6"	2'-3"	3'-10"	6'-1"	2'-6"
18"	9"	2'-9"	3'-10"	6'-1"	3'-0"
24"	9 1/2"	3'-7 1/2"	2'-6"	6'-1 1/2"	4'-0"
30"	1'-0"	4'-6"	1'-7 3/4"	6'-1 3/4"	5'-0"
36"	1'-3"	5'-3"	2'-10 3/4"	8'-1 3/4"	6'-0"
42"	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"
48"	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"
* 60"	2'-6"	5'-0"	3'-3"	8'-3"	8'-0"

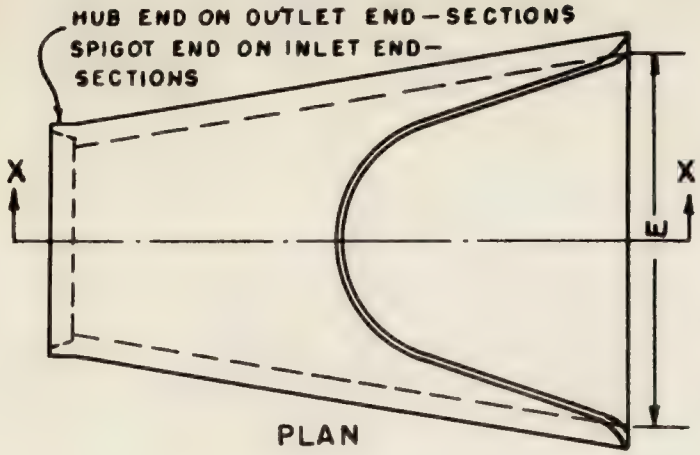
* 60" Special end section is based on the slope of a wing 2 to 1.

NOTE :- Reinforcing Steel & Concrete shall conform to Specifications for Reinforced Conc. Pipe.

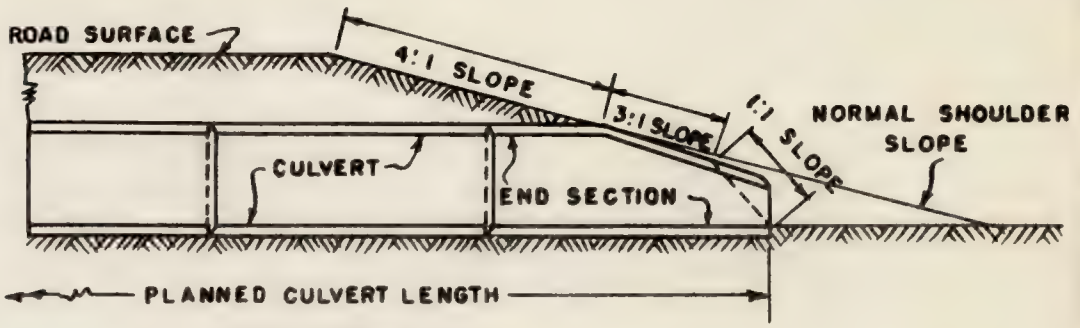
Montana State Highway Commission

APPROVED JUN. 1, 1946
R. H. Willcomb
ADMINISTRATIVE AID

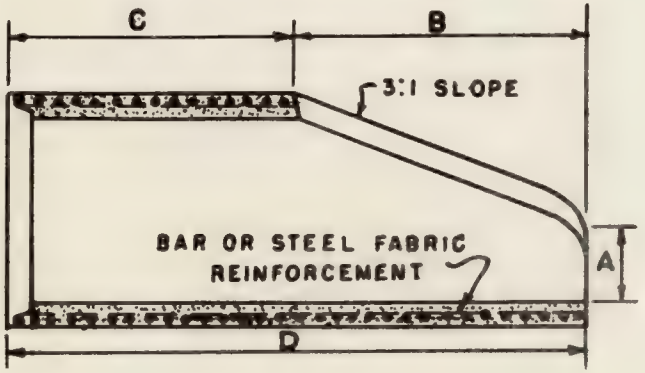
19-C7



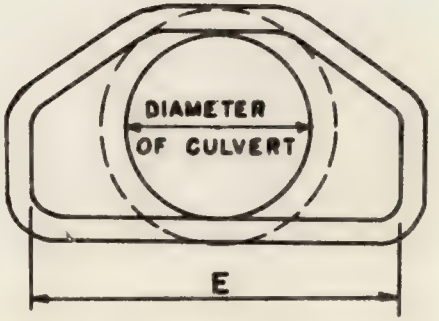
PLAN



SLOPE DETAIL



SECTION X-X



END VIEW

END SECTION DIMENSIONS					
DIAM	A	B	C	D	E
12"	4"	2'-0"	4'-0 7/8"	6'-0 7/8"	2'-0"
15"	6"	2'-3"	3'-10"	6'-1"	2'-6"
18"	9"	2'-3"	3'-10"	6'-1"	3'-0"
24"	9 1/2"	3'-7 1/2"	2'-6"	6'-1 1/2"	4'-0"
30"	1'-0"	4'-6"	1'-7 3/4"	6'-1 3/4"	5'-0"
36"	1'-3"	5'-3"	2'-10 3/4"	8'-1 3/4"	6'-0"
42"	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"
48"	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"

NOTE:- REINFORCING STEEL & CONCRETE SHALL CONFORM TO SPECIFICATIONS FOR REINFORCED CONC. PIPE.

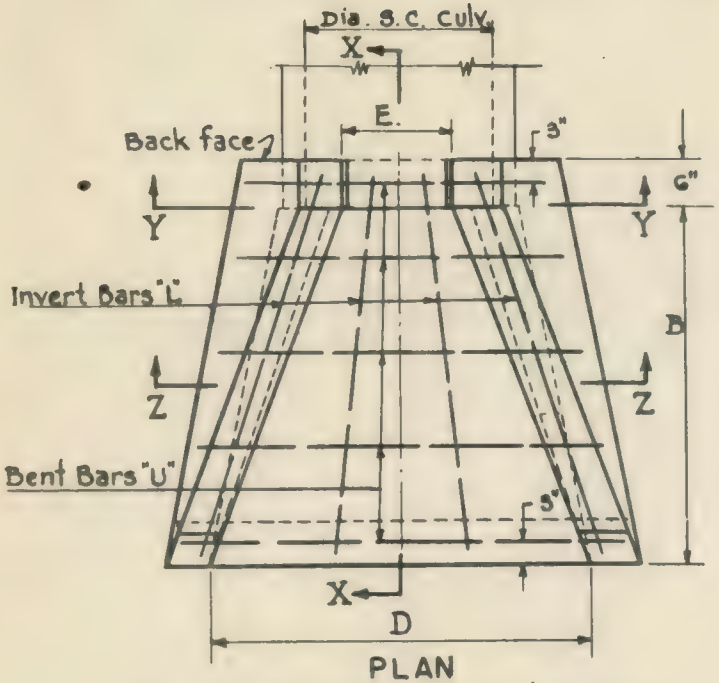
FLARED END TERMINAL SECTION FOR REINFORCED SECTIONAL CONC. PIPE (PREFABRICATED).

Montana State Highway Commission

APPROVED 10/25/48
ADMINISTRATIVE AID

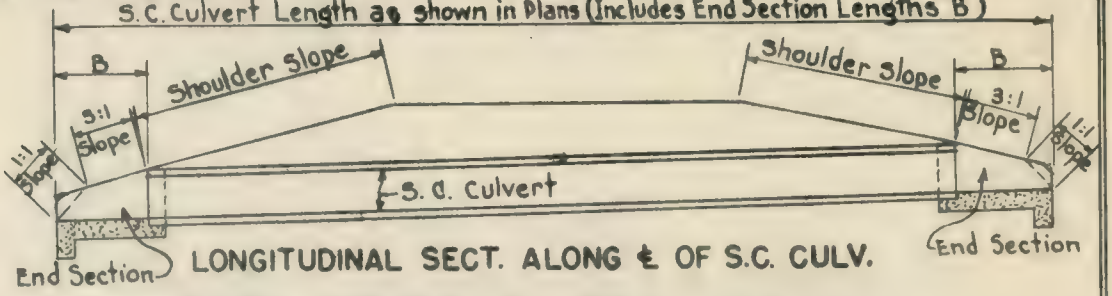
19-C72

FLARED END TERMINAL SECTION FOR REINFORCED SECTIONAL CONC. PIPE. (CAST IN PLACE)



PLAN

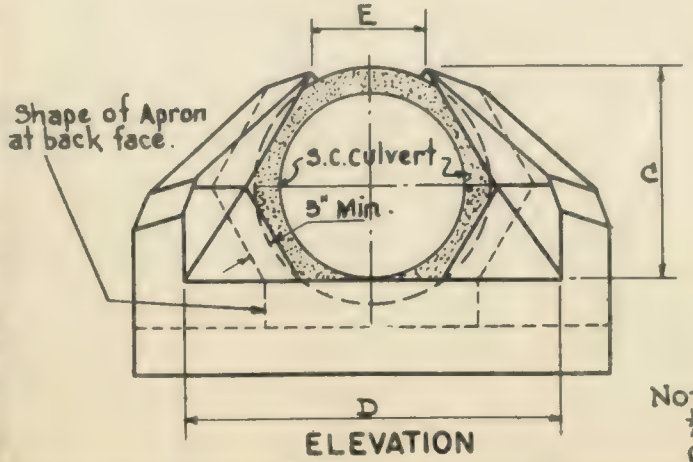
Showing Reinforcing in invert of Apron. Sidewall Reinforcing not shown.



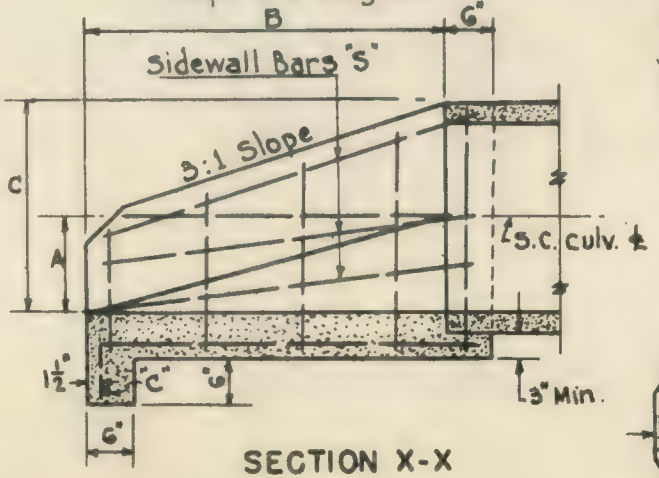
LONGITUDINAL SECT. ALONG ℄ OF S.C. CULV.

ESTIMATE QUANTITIES							GENERAL DIMENSIONS					
CULV. DIA.	CONC.	STL.	NO. REINF. BARS. G	L	S	U	A	B	C	D	E	T
12"	0.2 C.Y.	26 Lb.	1	3	6	3	6"	2'-0"	1'-2"	2'-0"	6¾"	6"
15"	0.3 "	35 "	1	4	6	4	7½"	2'-5½"	1'-5½"	2'-6"	8¼"	6"
18"	0.4 "	42 "	1	4	6	4	9"	2'-10½"	1'-8½"	3'-0"	9¾"	6"
24"	0.6 "	58 "	1	4	6	5	12"	3'-9"	2'-3"	4'-0"	12¾"	6"
30"	1.0 "	77 "	1	4	6	6	15"	4'-7½"	2'-9½"	5'-0"	15¾"	6½"
36"	1.4 "	87 "	1	4	6	6	18"	5'-6"	3'-4"	6'-0"	18"	7"
42"	1.9 "	107 "	1	4	6	7	21"	6'-4½"	3'-10½"	6'-6"	21¼"	7½"
48"	2.4 "	136 "	1	5	6	8	24"	7'-3"	4'-5"	7'-0"	23¾"	8"
* 60"	3.0 "	160 "	1	5	6	8	30"	6'-6"	5'-6"	7'-4"	30"	10"

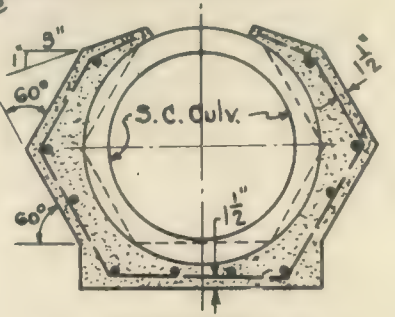
*60" Special end section is based on the slope of a wing 2:1.



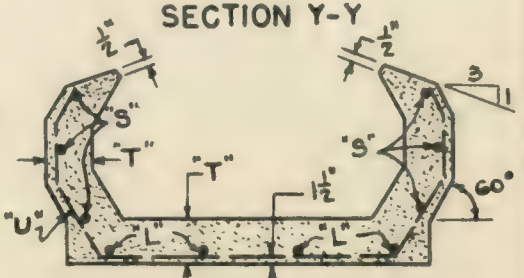
ELEVATION



SECTION X-X



SECTION Y-Y



SECTION Z-Z

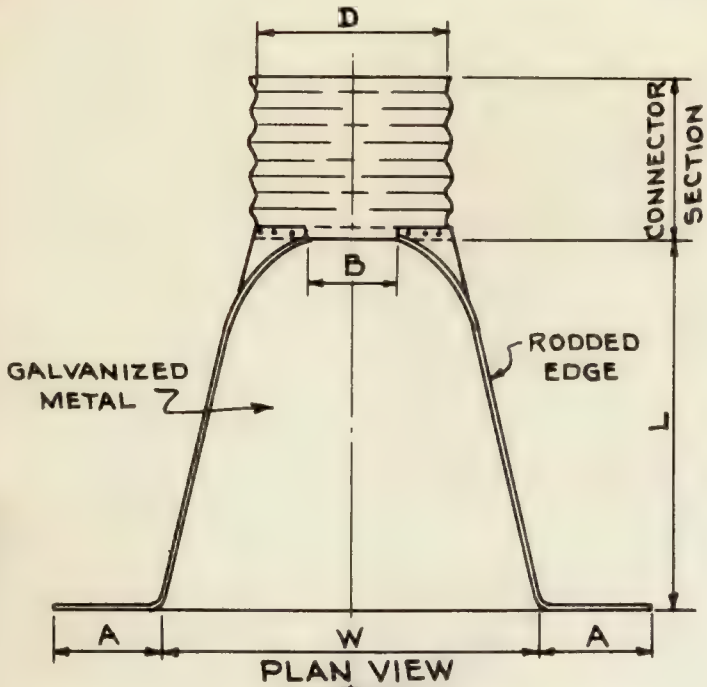
NOTE:- The Reinforcement Steel to be ½" deformed bars. Concrete to be Class "D"

APPROVED JUN. 1, 1946
R.M. Hillcourt
ADMINISTRATIVE AID

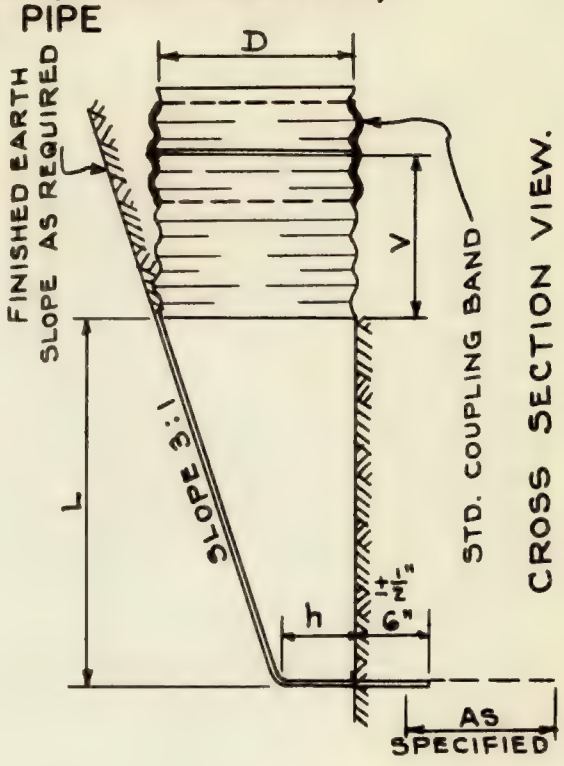
Montana State Highway Commission

20-C 71

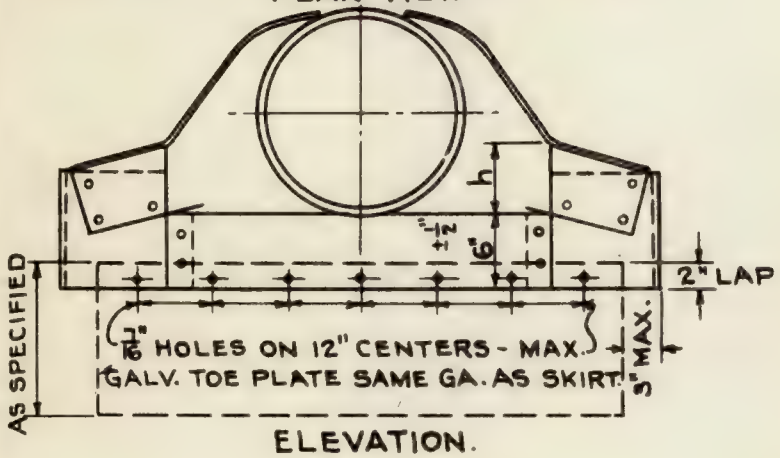
FLARED END TERMINAL SECTION (PREFABRICATED) FOR CORRUGATED METAL PIPE



PLAN VIEW



CROSS SECTION VIEW.



ELEVATION.

CULV. DIA.	DIMENSIONS					
	"A" (MIN.)	"B" (MAX.)	"L" (2" TOL.)	"W" (2" TOL.)	"h" (½" TOL.)	"V"
12"	9"	6"	24"	24"	4"	7"
15"	9"	7½"	30"	30"	5"	7"
18"	9"	9"	36"	36"	6"	7"
21"	9"	11"	42"	42"	7"	7"
24"	9"	12"	46"	48"	8"	7"
30"	9"	15"	60"	59"	10"	7"
36"	14"	18"	72"	70"	12"	12"
42"	14"	21"	84"	82"	14"	12"
48"	14"	24"	96"	94"	16"	12"

TOE PLATE TO BE PUNCHED WITH 7/16" HOLES TO MATCH HOLES IN SKIRT LIP. 3/8" GALV. BOLTS TO BE FURNISHED. LENGTH OF TOE PLATE EXT. SHOWN ON PLANS. AVAILABLE STANDARD DEPTHS - 12", 15", 18", 24", 30", 36" & 48".

TOE PLATE EXTENSIONS TO BE USED ONLY WHEN SPECIFIED.

SKIRT SECTION FOR 12" TO 24" DIA. PIPE INCL. TO BE MADE IN ONE PIECE.

SKIRT SECTION FOR 30" TO 48" DIA. PIPE INCL. MAY BE MADE FROM TWO SHEETS WITH LAP RIVETED SPLICE ON ℄.

CONNECTOR SECTION, SKIRT, CORNER PLATES AND TOE PLATE TO BE GALV. AND SAME GAGE AS PIPE.

APPROVED April 3, 1948
R. A. Wilcomb
ADMINISTRATIVE AID.

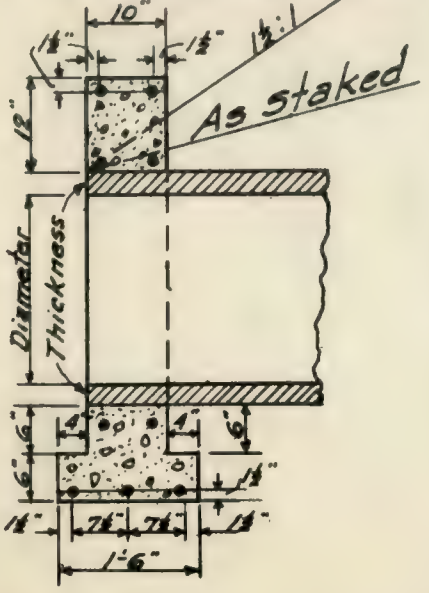
Montana State Highway Commission.

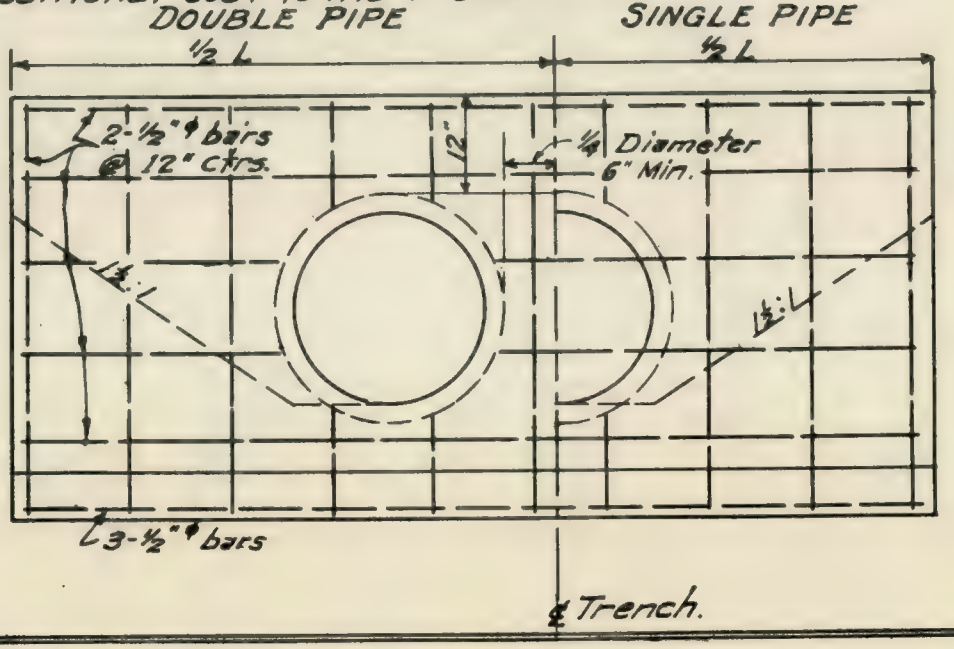
CONCRETE HEADWALLS FOR PIPE CULVERTS

CUBIC YARDS OF CLASS "B" CONCRETE

DIAM. OF PIPE	SINGLE CORR. METAL				DOUBLE CORR. METAL				DIAM. OF PIPE	THICKNESS OF SHELL	SINGLE CONC. PIPE				DOUBLE CONC. PIPE			
	AREA SQ. FT. 1 PIPE	L	CU. YDS ONE HDWL	CU. YDS TWO HDWLS	AREA SQ. FT. 2 PIPES	L	CU. YDS ONE HDWL	CU. YDS TWO HDWLS			OUTSIDE AREA SQ. FT. 1 PIPE	L	CU. YDS. ONE HDWL	CU. YDS TWO HDWLS	OUTSIDE AREA SQ. FT. 2 PIPES	L	CU. YDS. ONE HDWL	CU. YDS. TWO HDWLS
18"	1.767	6'-0"	0.67	1.34	3.534	8'-3"	0.88	1.77	18"	2½"	2.885	6'-0"	0.71	1.42	5.770	8'-8"	0.98	1.95
24"	3.142	8'-0"	0.99	1.98	6.284	11'-0"	1.30	2.60	24"	3"	4.909	8'-0"	1.06	2.12	9.818	11'-6"	1.44	2.87
30"	4.908	10'-0"	1.36	2.72	9.816	13'-9"	1.78	3.55	30"	3½"	7.467	10'-0"	1.46	2.92	14.934	14'-4"	2.10	4.20
36"	7.068	12'-0"	1.78	3.56	14.136	16'-6"	2.32	4.63	36"	4"	10.559	12'-0"	1.92	3.84	21.118	17'-2"	2.56	5.12
42"	9.621	14'-0"	2.25	4.50	19.242	19'-3"	2.91	5.82	42"	4½"	14.186	14'-0"	2.44	4.87	28.372	20'-0"	3.23	6.46
48"	12.566	16'-0"	2.77	5.54	25.132	22'-0"	3.57	7.14	48"	5"	18.348	16'-0"	3.01	6.01	36.696	22'-10"	3.96	7.93
60"	19.635	20'-0"	3.96	7.92	39.270	27'-6"	5.07	10.14	60"	6"	28.274	20'-0"	4.31	8.62	54.548	28'-6"	5.64	11.29

NOTE :- Standard reinforced concrete pipe to be used where emb. is less than 20'
Extra strength reinforced concrete pipe to be used under emb. of more than 20'.
Minimum cover to finished grade = ¼ diam. pipe but not less than 1.0'.
Minimum overall length of culvert = crown of roadway plus 4.0'.
Reinforcing as indicated shall be included in the unit price bid for concrete.
Length of bars = L - 6". All exposed edges of concrete to be chamfered 1"
Class "A" Conc. can be substituted by the contractor with the approval of the Engineer at no additional cost to the State.





APPROVED JUN. 1, 1946
R.H. Wilcomb
ADMINISTRATIVE AID

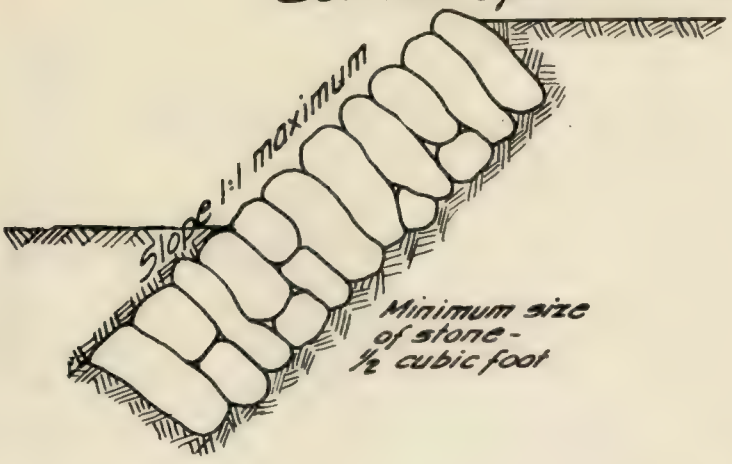
Montana State Highway Commission

21-M6

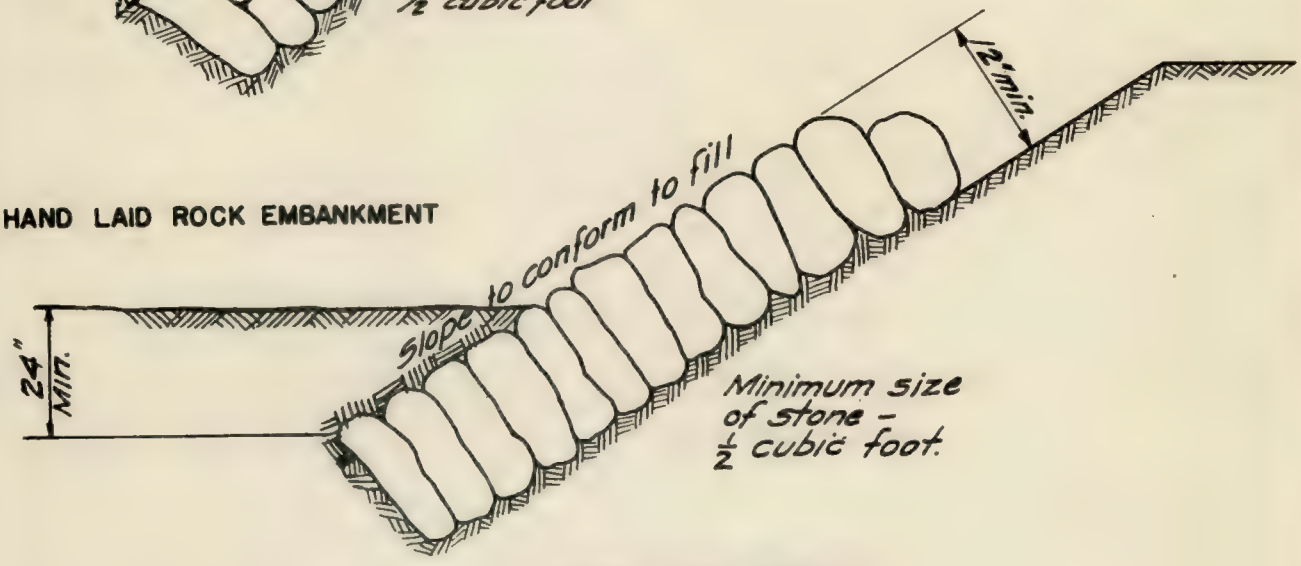
BANK PROTECTION (See Std. CRR1 for Grouted Riprap.)

Scale - 3/8" = 1'-0"

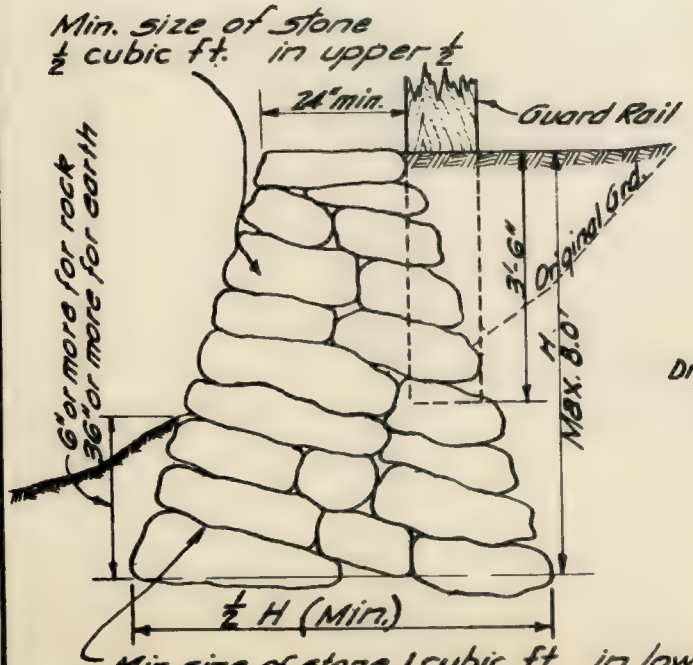
See Std. Specifications.



HAND LAID ROCK EMBANKMENT



HAND LAID RIPRAP


Min. size of Stone ½ cubic ft. in upper ½
24" min.
Guard Rail
Original Grd.
3'-6"
Max. 8'-0"
36" or more for rock
48" or more for earth
½ H (Min.)
Min size of stone 1 cubic ft. in lower ½

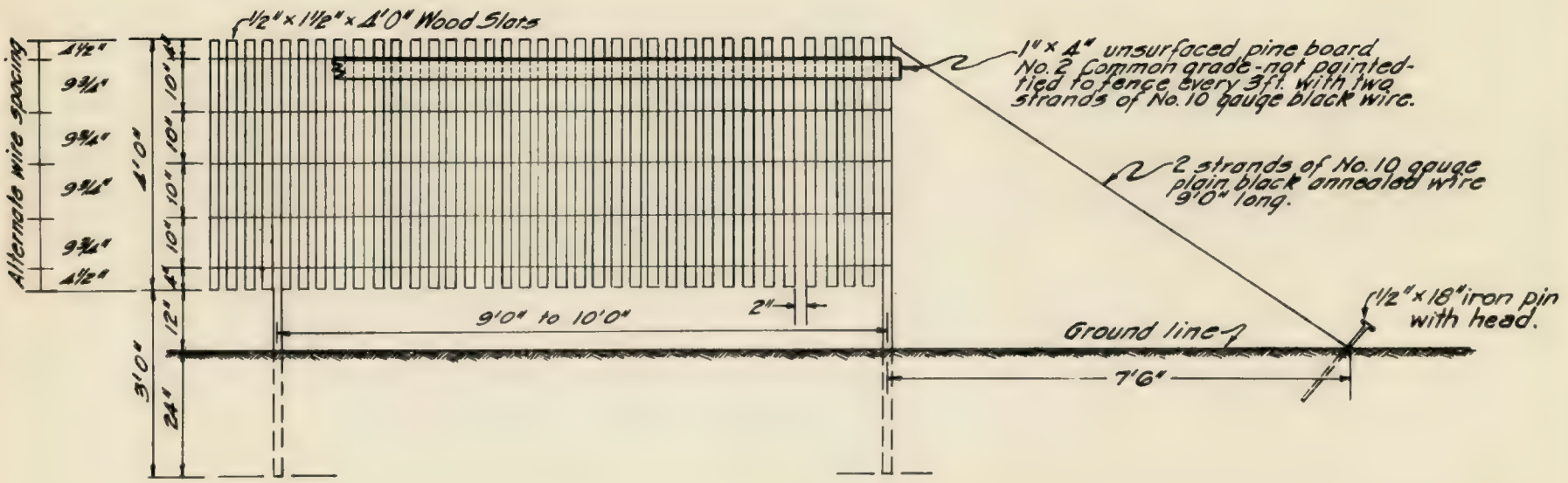
DRY RUBBLE MASONRY

Dry Rubble Masonry will not be used where a railroad is located on the downhill side of highway.

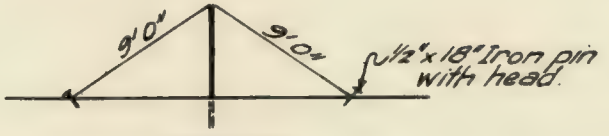
Montana State Highway Commission

APPROVED JUN. 1, 1946
ADMINISTRATIVE AID

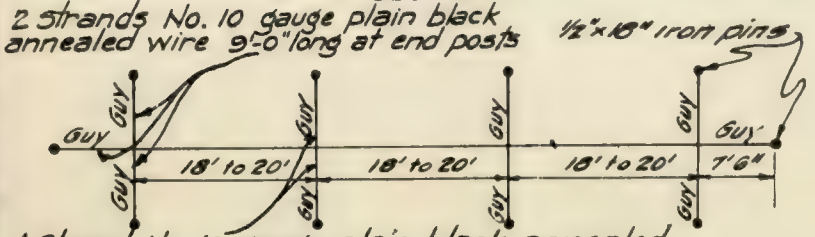
WOVEN WIRE WOOD SLAT SNOW FENCE



METHOD OF GUYING



SECTION


2 Strands No. 10 gauge plain black annealed wire 9'-0" long at end posts
1/2" x 18" iron pins
Guy
18' to 20'
18' to 20'
18' to 20'
7'6"
1 Strand No. 10 gauge plain black annealed wire 9'-0" long at intermediate posts.

PLAN

Posts: to be 7'0" long and furnished without anchor. Posts shall be given at least one coat of approved paint. The section form of posts may be tubular, tee, equal angle, tee rail or modified channel provided that all posts weigh at least 1.33 pounds per lineal foot.

Wood Slats: 1/2" x 1 1/2" x 4'0" woven together with 5 cables, each consisting of 2 galvanized wires - not smaller than No. 12 1/2 (A S & W gauge). Slats to be placed 2" apart. Each cable to have 2 complete turns in the weave in each space between slats. All slats to be immersed in hot solution of creosote or red oxide of iron.

Montana State Highway Commission.

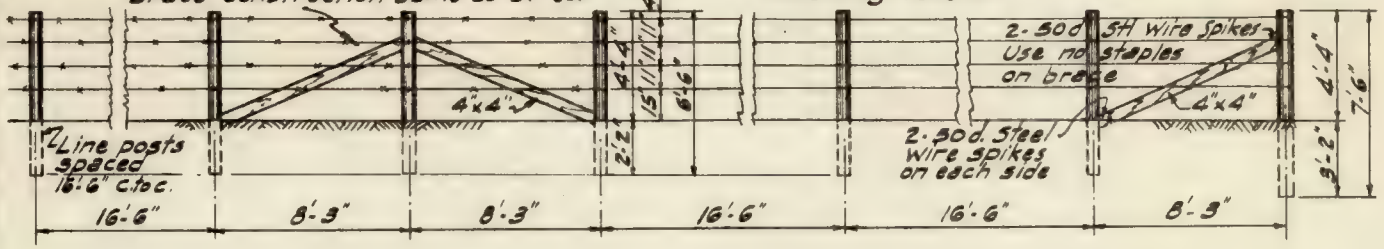
Approved JUN 1, 1946
ADMINISTRATIVE AID

23-551

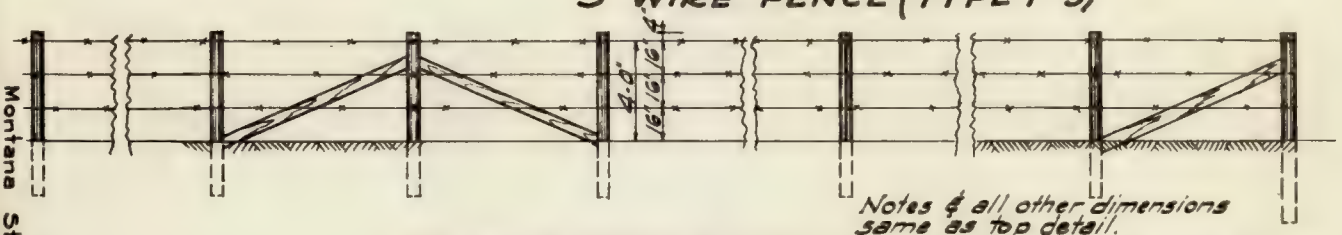
4 WIRE FENCE (TYPE F-4)

Stretching Post 1320' Max. from cor post or as required by ground line. Brace construction same as at cor.

Brace corner & gate posts as below. Corner posts to be braced on all sides receiving tension.

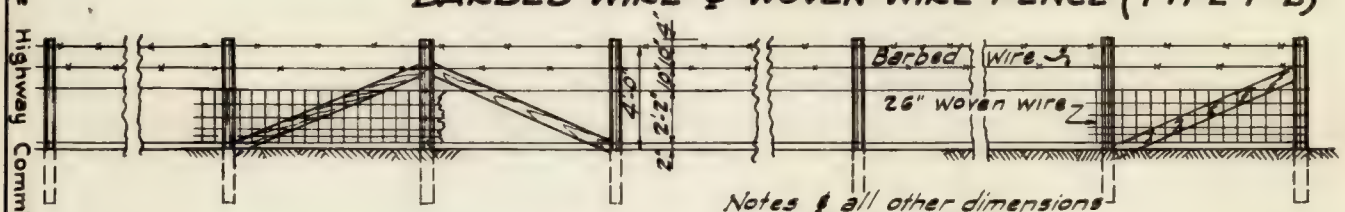


3 WIRE FENCE (TYPE F-3)



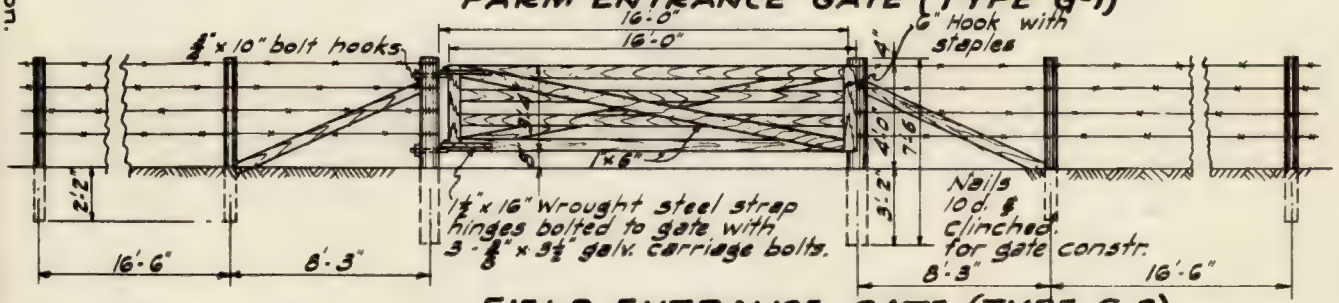
Notes & all other dimensions same as top detail.

BARBED WIRE & WOVEN WIRE FENCE (TYPE F-2)

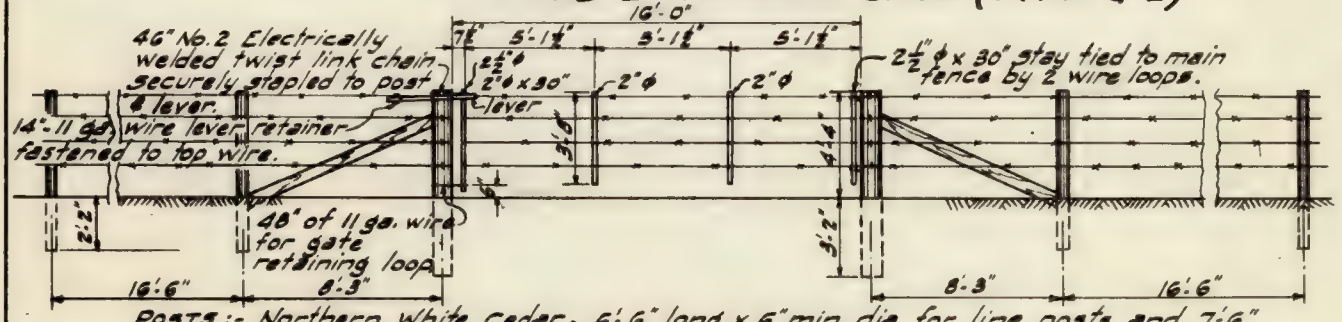


Notes & all other dimensions same as top detail.

FARM ENTRANCE GATE (TYPE G-1)



FIELD ENTRANCE GATE (TYPE G-2)


16'-0"
46" No. 2 Electrically welded twist link chain securely stapled to post & lever.
14"-11 ga. wire lever retainer fastened to top wire.
2½"ϕ
2"ϕ x 30" lever
2"ϕ
2"ϕ
2½"ϕ x 30" stay tied to main fence by 2 wire loops.
48" of 11 ga. wire for gate retaining loop
16'-6"
8'-3"
8'-3"
16'-6"

POSTS :- Northern White Cedar, 6'-6" long x 6" min. dia. for line posts and 7'-6" long x 8" min. dia. for corner & gate posts.

WIRE :- 2 point galv. barbed wire, approx. 350 lbs. per mile, 2 strands of 12 ga. wire twisted, with barbs spaced 5" apart. Woven wire 26" wide. Top & bottom wires #10 ga. Lines & stay wires #12½ ga. Stays 12" apart.

LUMBER : Full sawed Montana Larch, or Montana or Pacific Coast Douglas Fir. Braces may also be constructed of peeled round poles of a minimum diameter of 4".

STAPLES : 1½" galvanized fence staples #9 wire.

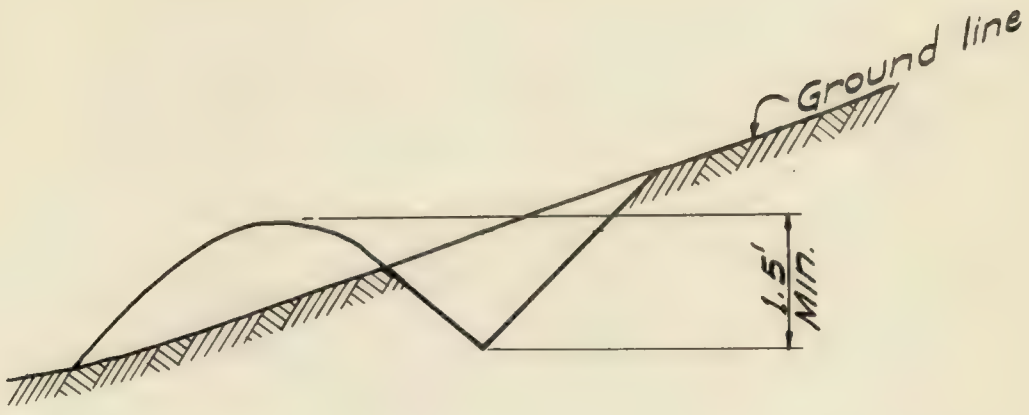
ALTERNATE CONSTRUCTION.
Metal posts may be used in place of wood posts. Installation will be done according to manufacturers recommendations.
Leaning fence may be substituted if approved by the Engineer.

APPROVED JUN. 1, 1946
C.M. Williamson
ADMINISTRATIVE AID

Montana State Highway Commission.

RIGHT OF WAY FENCE

FURROW DITCH

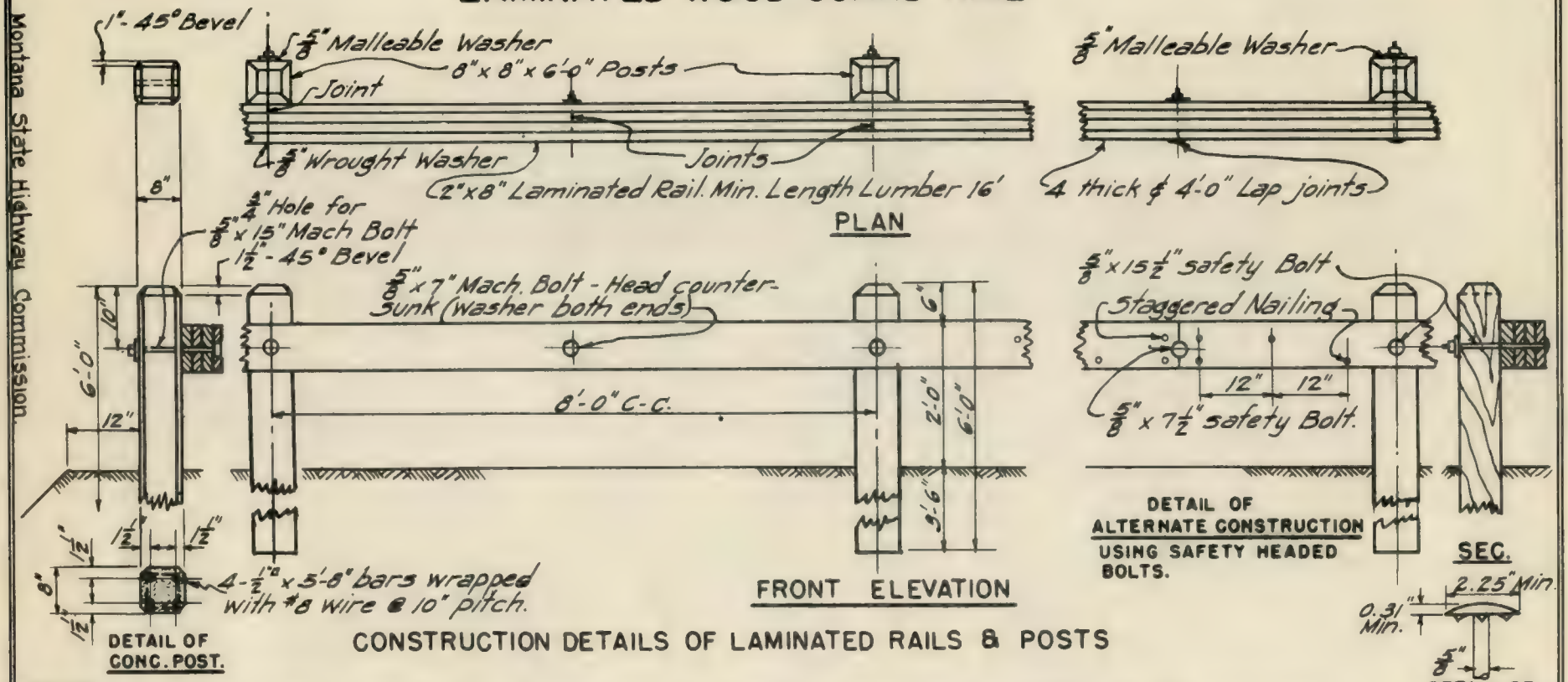


Exc. approx. 8 cu. Yds. per Station.

Montana State Highway Commission.

APPROVED JUN. 1, 1946
R. A. Willcomb
ADMINISTRATIVE AID

LAMINATED WOOD GUARD RAIL



CONSTRUCTION DETAILS OF LAMINATED RAILS & POSTS

Montana State Highway Commission

APPROVED JUN 13 1946
R. H. Willcoxon
ADMINISTRATIVE AID

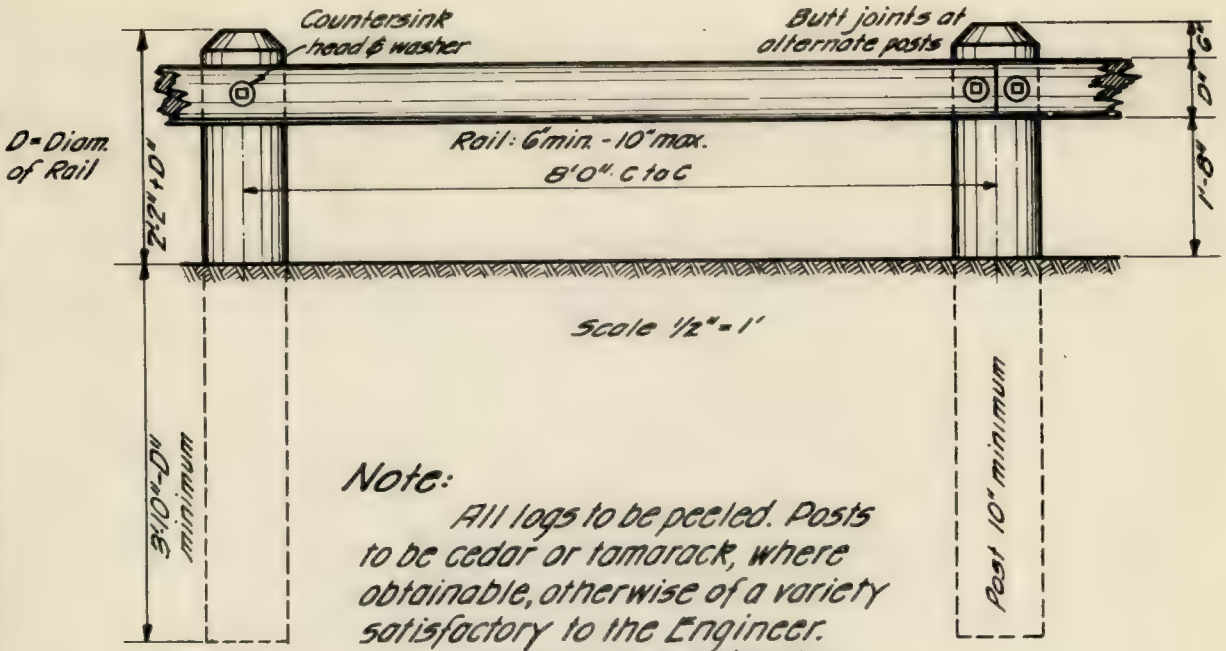
LUMBER - Posts shall be of concrete, or treated wood as specified in the proposal form or special provisions. Railings shall meet the requirements in the standard specifications.

PAINT — Railings & Posts shall be painted in accordance with the standard specifications. Painting of concrete posts will not be required. End panels to be flared as directed by the Engineer. All hardware except nails to be galvanized. Nail 1st. plank to post (where wood posts are used) with 40d. nails, 2nd. plank to 1st. with 10d. nails, 3rd. to 2nd. with 20d. nails - 4th. to 3rd. with 40d. nails. Nailing to be on 2 ft. centers staggered top and bottom 2" inside of edge with joints nailed top & bottom.

NOTE — Painting, Nailing etc. & all dimensions same for either alternate (Where wood posts are used.)

26-GE1

RUSTIC GUARD RAIL

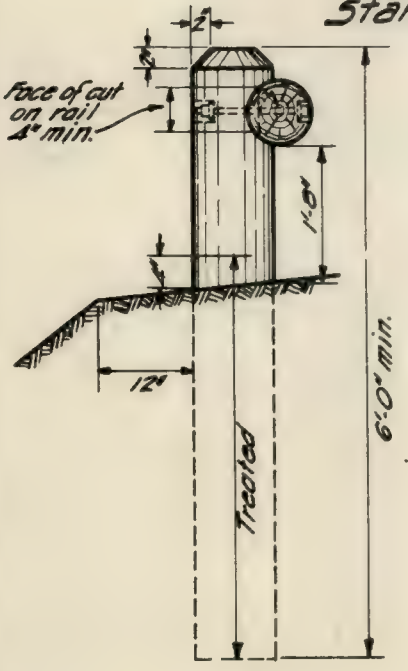


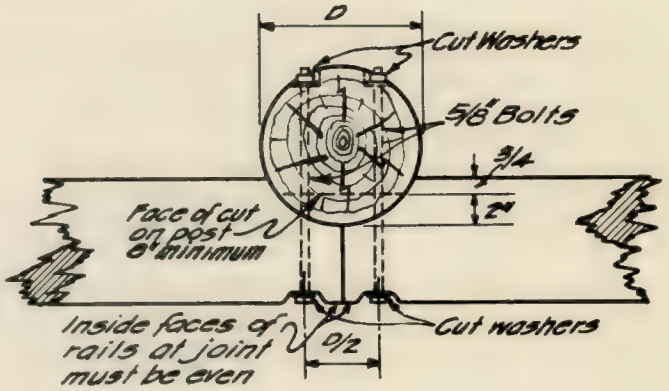
Note:

All logs to be peeled. Posts to be cedar or tamarack, where obtainable, otherwise of a variety satisfactory to the Engineer.

Dimensions for dapping constant for all sizes of posts.

All posts, railing & fittings shall be erected in accordance with the Standard Specifications.



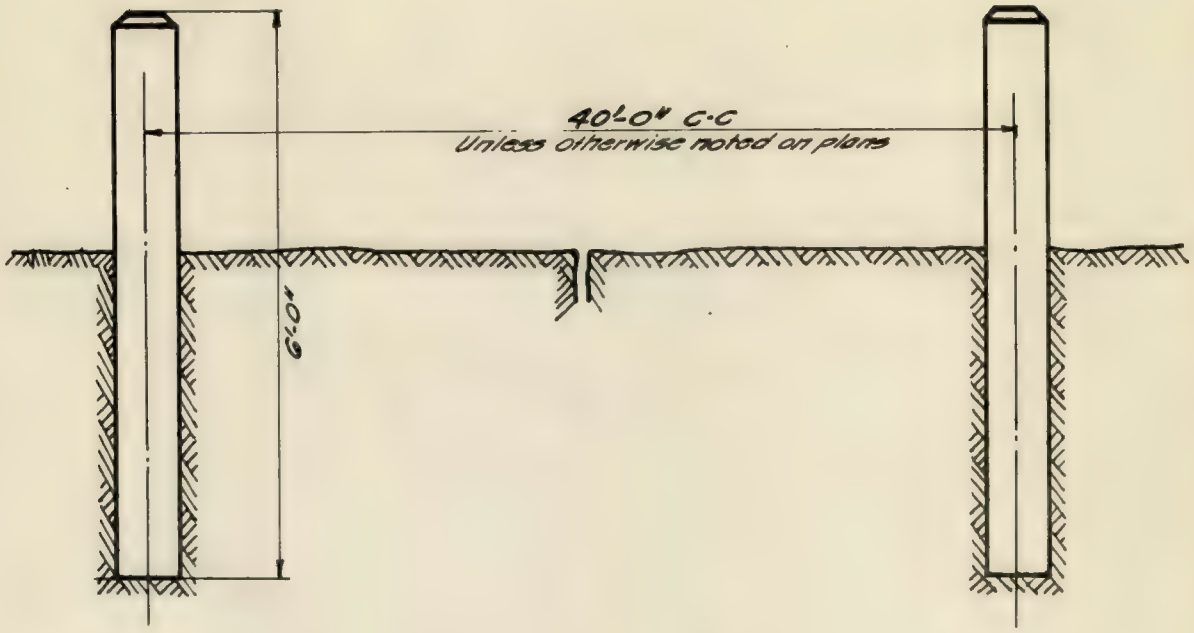


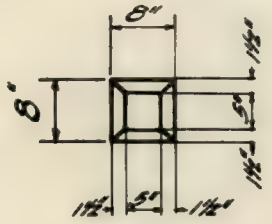
NOTE:- These details to be used as guide in making finished design.
Guard rail to be special design to fit locality and conditions.

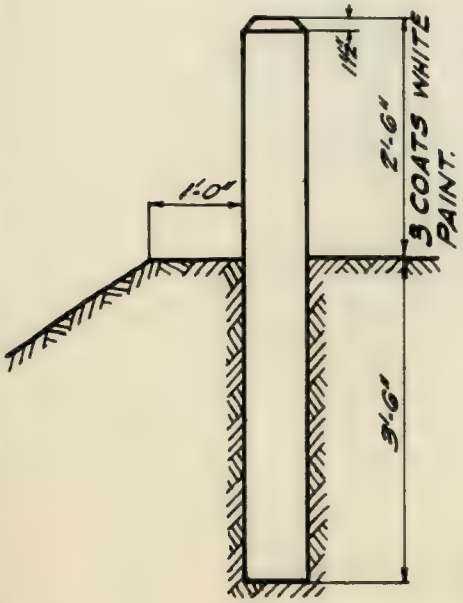
Approved JUN. 1 1946
C. H. Willcomb
ADMINISTRATIVE AID

Montana State Highway Commission.

DETAIL OF GUIDE POSTS







TREATED POSTS.

POSTS - Shall be treated wood as specified in the proposal form or Special Provisions.

LUMBER - to meet the requirements for Posts in the Standard Specifications.

PAINT - Three coats white paint top of post to ground line.

UNTREATED POSTS.

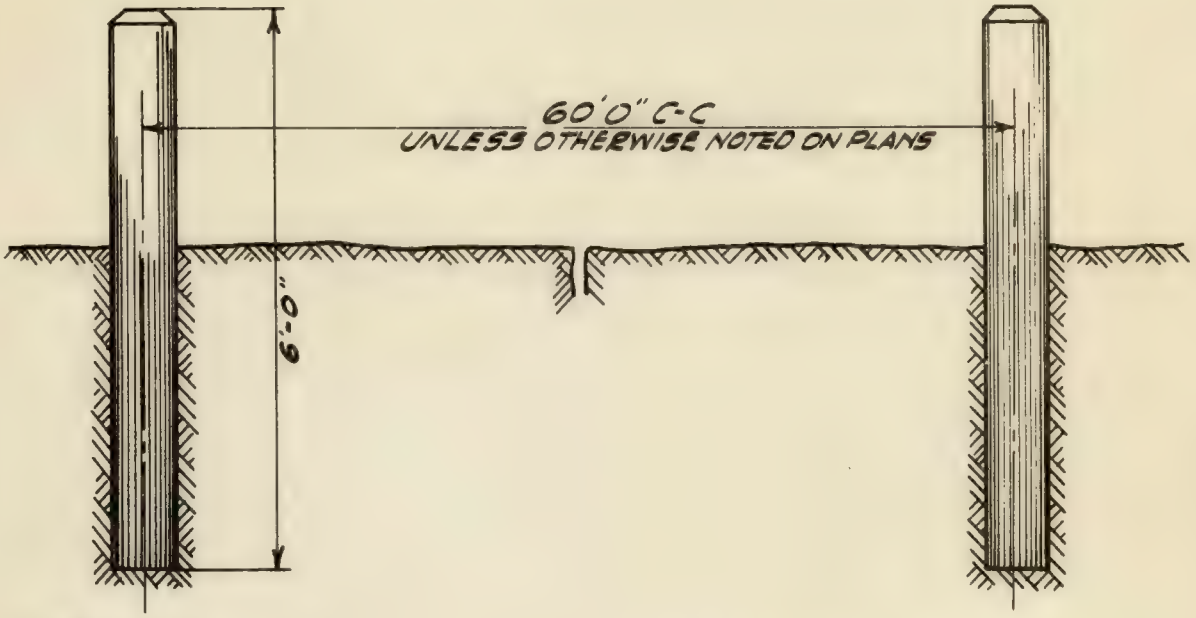
POSTS - Shall first be painted with 3 coats of approved black paint from bottom to a point 8" above ground line. From this point to top of post paint with 3 coats of approved white paint.

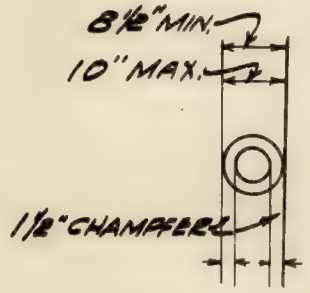
LUMBER - As noted above.

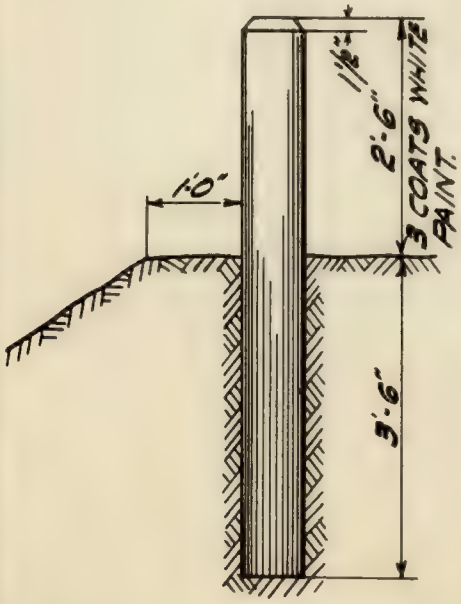
APPROVED JUN. 1, 1946
R. A. Hillcomb
ADMINISTRATIVE AID

Montana State Highway Commission.

ROUND WOOD GUIDE POSTS







TREATED POSTS

POSTS MAY BE OF DOUGLAS FIR, PONDEROSA, PINE, NORTHERN WHITE CEDAR, WESTERN RED CEDAR, LARCH OR LODGEPOLE PINE. POSTS SHALL BE STRAIGHT, SOUND, AND FREE FROM DEFECTS OF ALL KINDS, AND SHALL BE CUT FROM LIVE TREES NOT LESS THAN 30 DAYS, NOR MORE THAN 1 YEAR IN ADVANCE OF USE. ALL BARK SHALL BE PEELED AND THE POSTS TRIMMED SMOOTH OF ALL KNOTS AND PROJECTIONS.

UNLESS OTHERWISE SPECIFIED IN THE SPECIAL PROVISIONS POSTS SHALL BE TREATED WITH PENTACHLOROPHENAL.

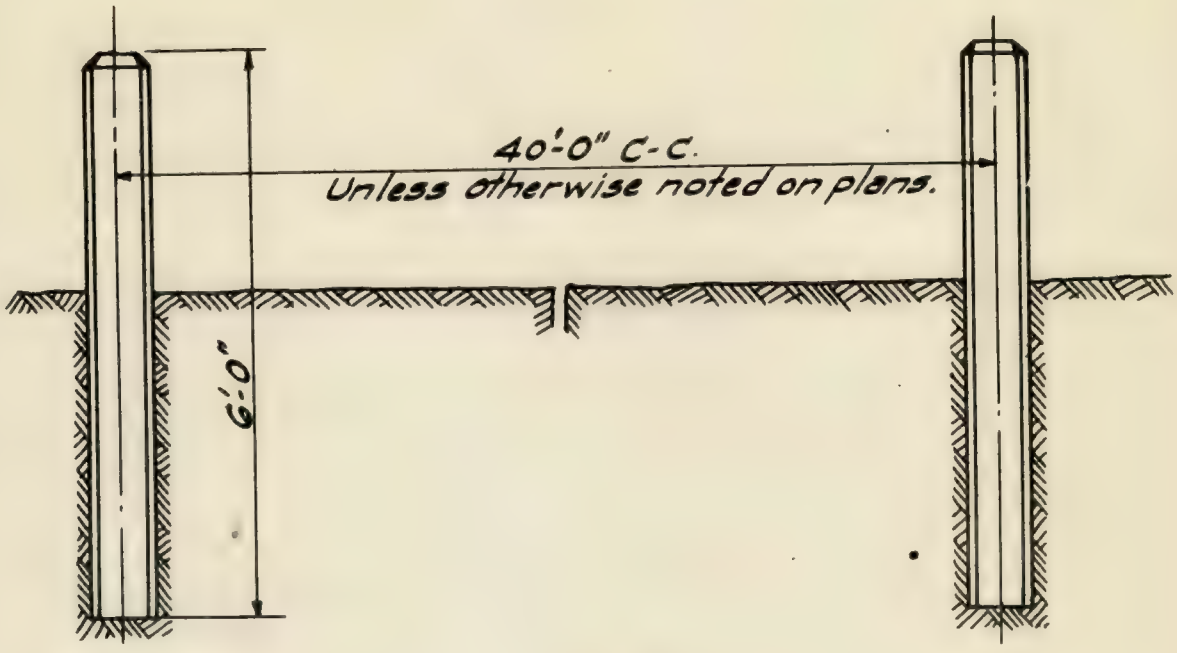
THE POSTS SHALL BE TREATED FOR THEIR ENTIRE LENGTH AND THE TREATMENT SHALL BE IN ACCORDANCE WITH SECTION 69 OF THE MONTANA STANDARD SPECIFICATIONS.

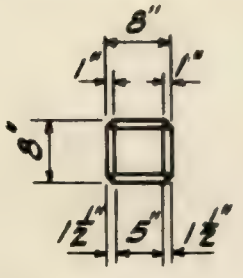
THAT PORTION OF THE POST ABOVE THE GROUND LINE SHALL BE PAINTED WITH THREE COATS OF WHITE PAINT.

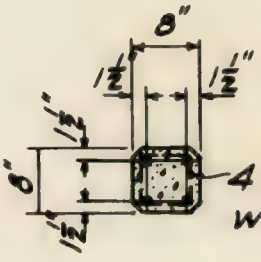
APPROVED February 3, 1949
P. O. Whipple
ADMINISTRATIVE AID

MONTANA STATE HIGHWAY COMMISSION

DETAIL OF CONCRETE GUIDE POSTS

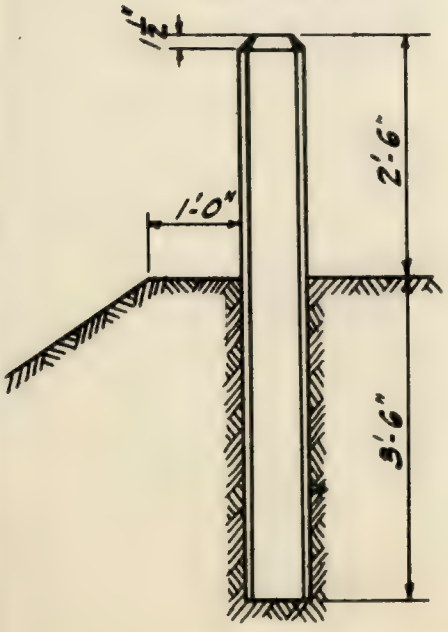






4 - ½" ø x 5'-8" Bars wrapped with #8 wire @ 10" pitch.

SEC.

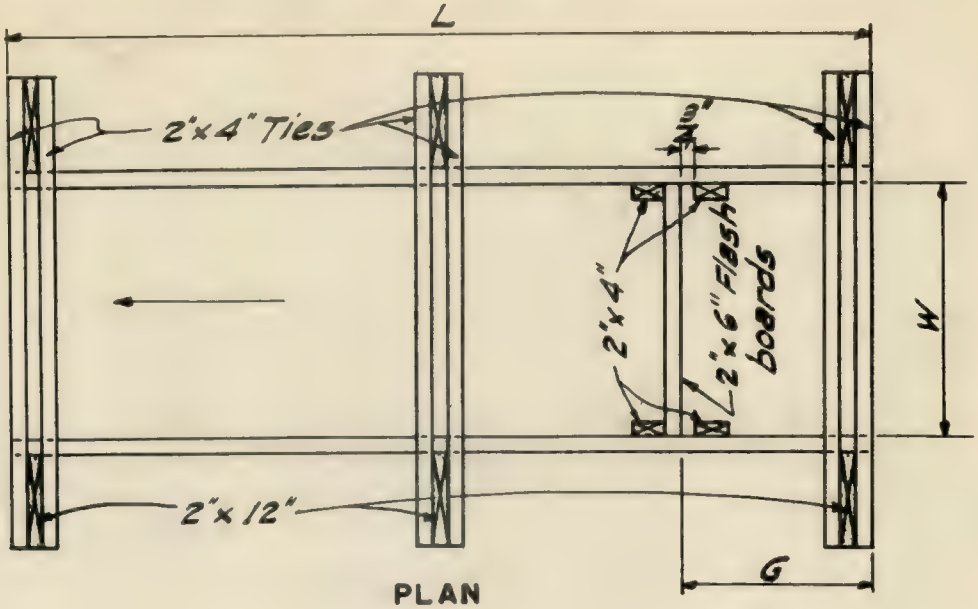


Concrete in Posts shall be Class "D."

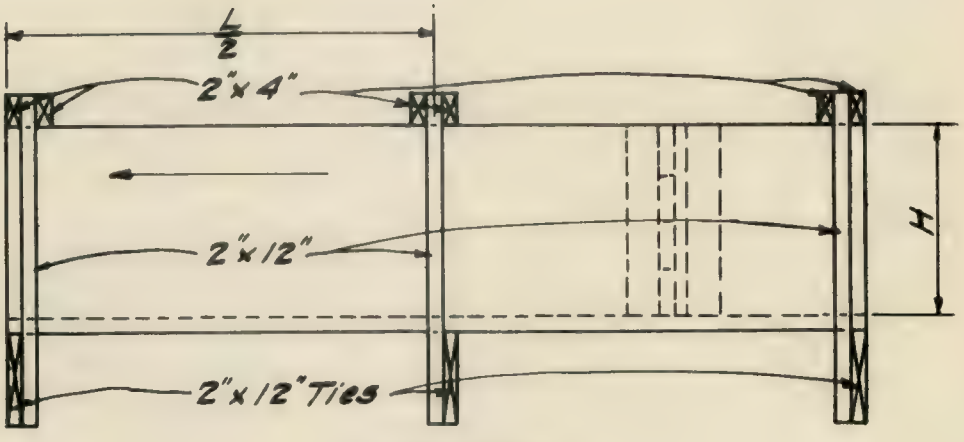
Approved JUN. 1, 1946
P. H. Wilcomb
ADMINISTRATIVE AID

Montana State Highway Commission

IRRIGATION DITCH HEAD GATE



PLAN



ELEVATION

Sides & floor to be of 2" matched material.
L = 3 W, but not less than 8'
W. & H. to fit local conditions
G = H
If W is greater than 6', special design to be provided.

NOTE:- Place entrance end of headgate at the point where the high water line in the canal intersects the canal bank. In soils that are easily eroded, it may be necessary to extend the planking in the bottom & sides of the headgate to an intersection with the canal bank.

BILL OF MATERIAL

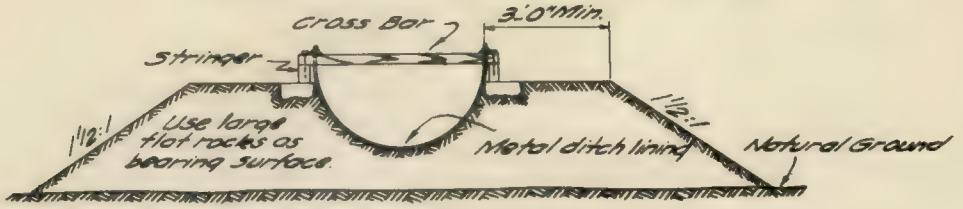
W = 1'-2"	H = 2'	180 FBM – (18")
W = 1'-8"	H = 2'	190 FBM – (24")
W = 2'-2"	H = 3'	250 FBM – (30")
W = 2'-8"	H = 3'	270 FBM – (36")

Use 12d. nails. Nails to be included in price bid for lumber.

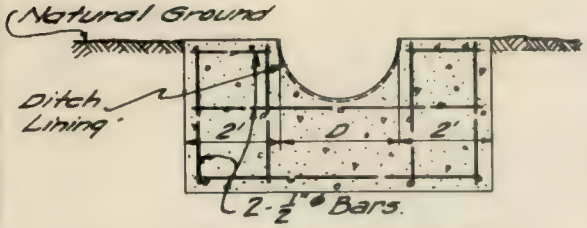
Montana State Highway Commission.

APPROVED JUN. 1, 1946
R. A. Willcomb
ADMINISTRATIVE AID

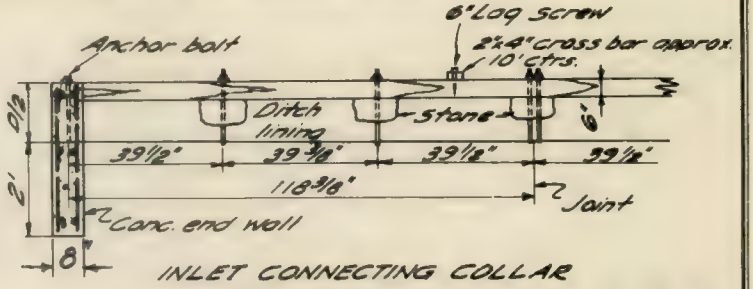
METAL DITCH LINING (LENNON TYPE)



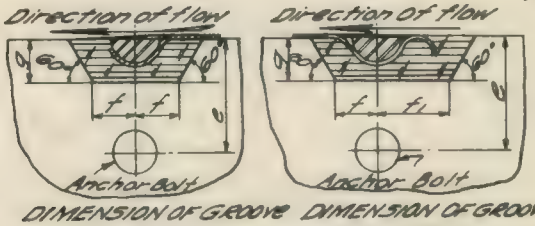
SECTION OF METAL DITCH LINING AND EMBANKMENT



CONCRETE INLET OR OUTLET.

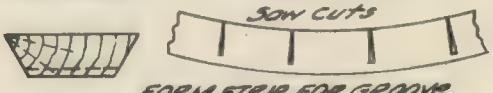


INLET CONNECTING COLLAR AND DITCH LINING FOR NO. 12 TO 48. FOR NO. 60 TO 84 JOINTS ARE 36" C. to C.

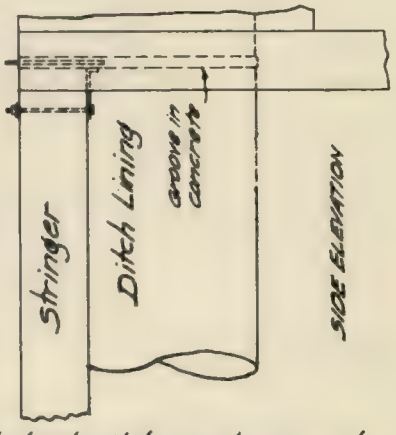


DIMENSION OF GROOVE FOR OUTLET

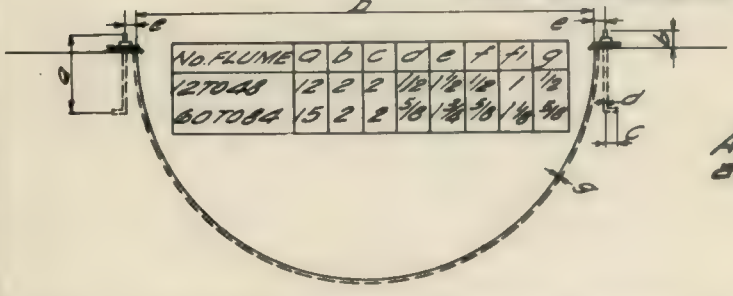
DIMENSION OF GROOVE FOR INTAKE



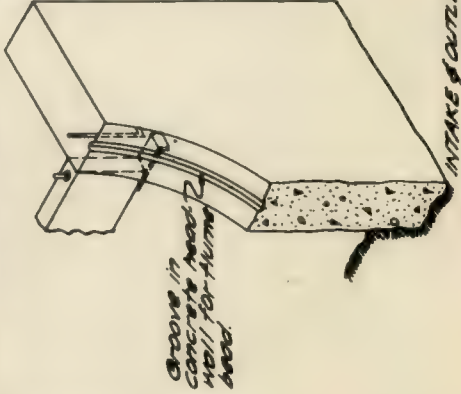
FORM STRIP FOR GROOVE
Soak in water before bending



All metal shall be galvanized as noted in Std. Specifications



No. FLUME	D	b	c	d	e	f	f1	g
12 TO 48	12	2	2	1/2	1/2	1/2	1	1/2
60 TO 84	15	2	2	5/8	1/2	5/8	1/4	5/16



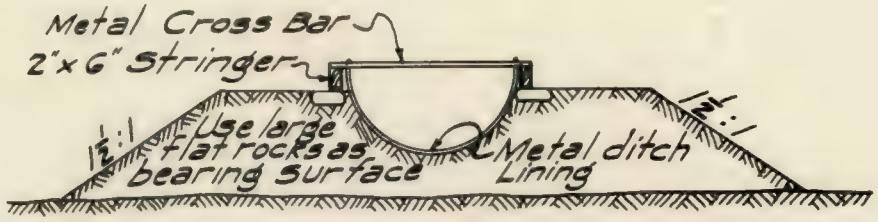
TRADE NO.	GAUGE	DIA. D.	AREA SQ. FT.	C.Y. CL "B" CONC.	CROSS BAR SIZE	CROSS BAR LENGTH	STRINGER SIZE	STRINGER LEN.	LBS. REIN. STL.
12	20	0'-7 5/8"	0.16	0.26	2"x4"	1'-2½"	2"x6"	MINIMUM LENGTH OF 10'	27.3
15	20	0'-9½"	0.25	0.28	2"x4"	1'-4½"	2"x6"		28.3
18	20	0'-11½"	0.36	0.30	2"x4"	1'-6½"	2"x6"		29.2
24	20	1'-3¼"	0.64	0.33	2"x4"	1'-10½"	2"x6"		30.8
30	20	1'-7⅛"	0.99	0.36	2"x4"	2'-2½"	2"x6"		32.6
36	20	1'-10⅞"	1.43	0.40	2"x4"	2'-6½"	2"x6"		34.2
42	20	2'-2¾"	1.95	0.43	2"x4"	2'-10"	2"x6"		36.0
48	20	2'-6½"	2.55	0.47	2"x4"	3'-2"	3"x6"		37.7
60	20	3'-2¼"	3.98	0.54	2"x4"	4'-0"	3"x6"		41.1
72	20	3'-9⅞"	5.73	0.61	2"x4"	4'-7½"	3"x6"		44.5
84	20	4'-5½"	7.80	0.69	3"x4"	5'-5"	3"x8"		47.9

* QUANTITIES OF CONC. ARE FOR ONE INLET OR OUTLET

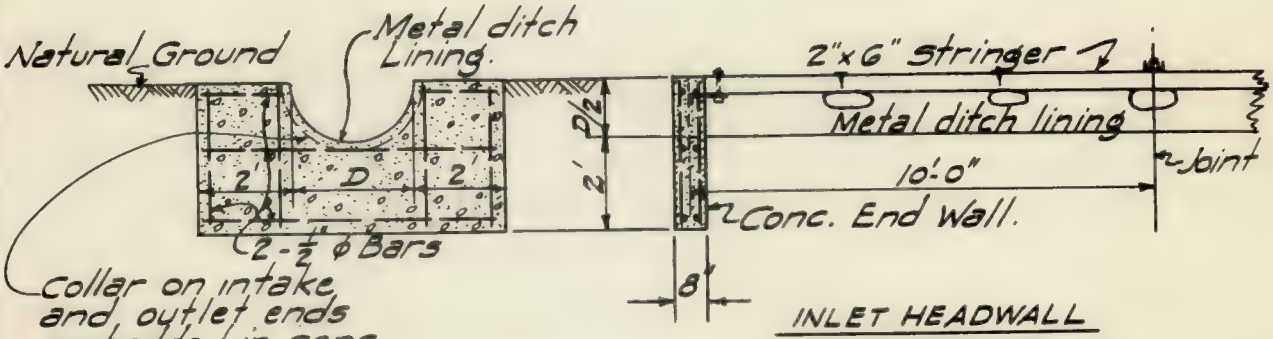
NOTE:- Curved sections of ditch require special mitred sections of metal ditch lining and longer cross bar. Reinforcing indicated to be included in the unit price bid for concrete.

APPROVED JUN. 1, 1946
C. A. Willcomb
ADMINISTRATIVE AID

METAL DITCH LINING.
(SIMPLEX TYPE)
See Special Provisions.

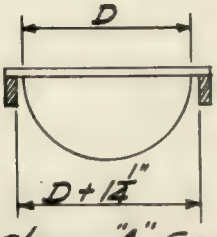


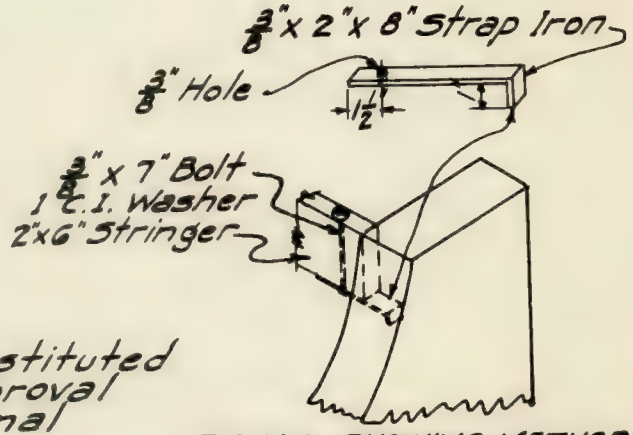
SECTION OF METAL DITCH LINING AND EMBANKMENT



CONC. INLET OR OUTLET HEADWALL.

INLET HEADWALL AND DITCH LINING





DETAIL SHOWING METHOD OF FASTENING 2"x6" STRINGERS TO HEADWALLS

NOTE:- Class "A" Conc. can be substituted by the contractor with the approval of the Engineer at no additional cost to the State.

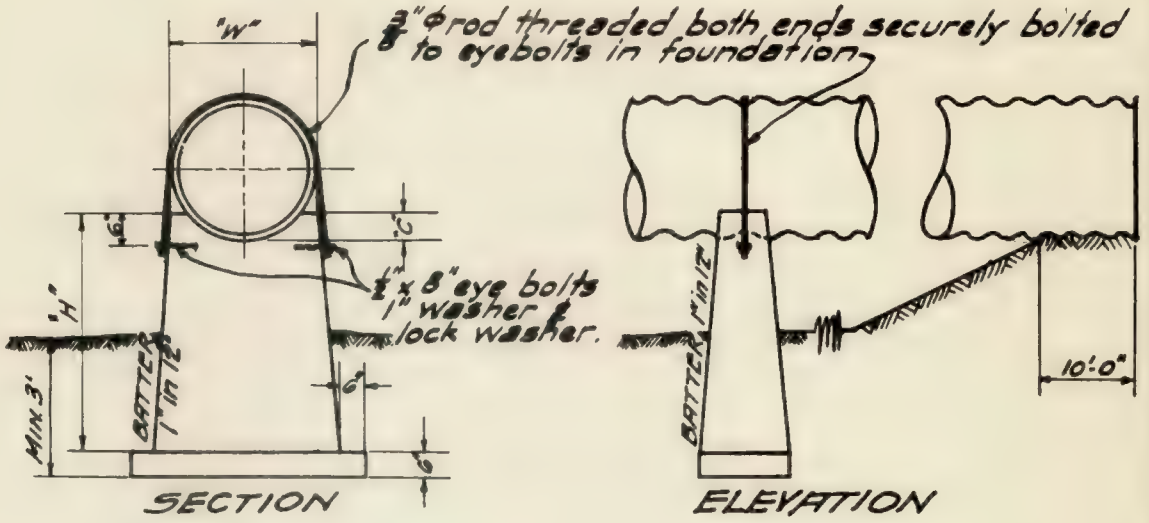
TRADE NO.	GAUGE	DIA "D"	AREA SQ.FT.	C.Y. CL. "B" CONC.	LBS. REINF. STL.	STRINGERS SIZE	STRINGERS LEN.
12	20	0'-7⅝"	0.16	0.26	27.3	2"x6"	MIN. LENGTH 10'
15	20	0'-9½"	0.25	0.28	28.3	2"x6"	
18	20	0'-11½"	0.36	0.30	29.2	2"x6"	
24	20	1'-3¼"	0.64	0.33	30.8	2"x6"	
30	20	1'-7⅛"	0.99	0.36	32.6	2"x6"	
36	20	1'-10⅞"	1.43	0.40	34.2	2"x6"	
42	20	2'-2¾"	1.95	0.45	36.0	2"x6"	

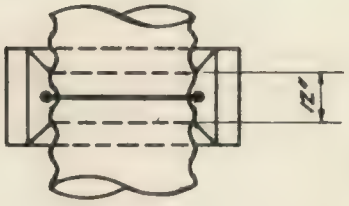
Quantities of Conc. & Steel are for one inlet or outlet.

NOTE:- Metal ditch lining to be installed in accordance with manufacturers instructions. Inside of lining to be given 2 coats of "Savolin" paint or equal. All metal to be galvanized as noted in the Standard Specifications. Reinforcing indicated to be included in the unit price bid for concrete.

APPROVED Jun 1. 1946
R. A. Willcomb
ADMINISTRATIVE AID

SUPPORTS FOR CORRUGATED METAL PIPES CARRYING IRRIGATION WATER ACROSS BORROW PITS





NOTE:- Where irrig. water is carried across borrow pits in straight metal pipes, a conc. hdwall (Std. S3) to be built at one or both ends of the pipe when, in the judgement of the Engineer, such protection against erosion is required.

DIAMETER OF *PIPE	MAXIMUM SPAN OF PIPE	"W"	"C"	CUBIC YARDS CLASS B CONC. IN ONE SUPPORT-FOR DIFFERENT VALUES OF "H"					
				3'	4'	5'	6'	7'	8'
18"	20'	20"	3"	.35	.50	.67	.87	1.10	1.36
24"	18'	24"	4"	.40	.57	.76	.99	1.24	1.54
30"	16'	30"	5"	.48	.67	.90	1.17	1.46	1.80
36"	16'	36"	6"	.55	.78	1.04	1.34	1.68	2.06
42"	14'	42"	7"	.62	.88	1.18	1.52	1.89	2.31
48"	12'	48"	8"	.69	.99	1.32	1.69	2.11	2.57

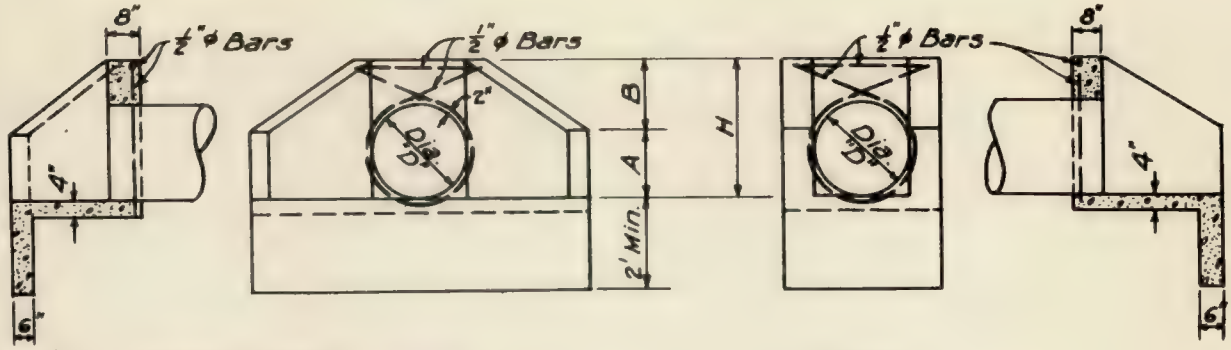
* NOTE: All irrigation pipe to be Syphon Pipe (class riveted and soldered water-tight.)

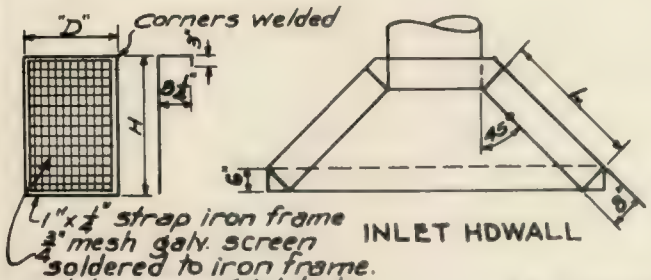
Class "A" Conc. can be substituted by the contractor with the approval of the Engineer at no additional cost to the state.

Approved JUN. 1, 1946.
J. A. Hillesund
ADMINISTRATIVE HD

Montana State Highway Commission

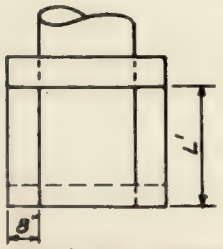
INLET & OUTLET HEADWALLS





INLET HDWALL

Inlet screen (Not to be used unless recommended by the Eng.)



OUTLET HDWALL

All exposed corners of concrete to be chamfered 1". Reinforcing steel to be not less than 1½" to nearest face of concrete.

INLET & OUTLET HEADWALLS

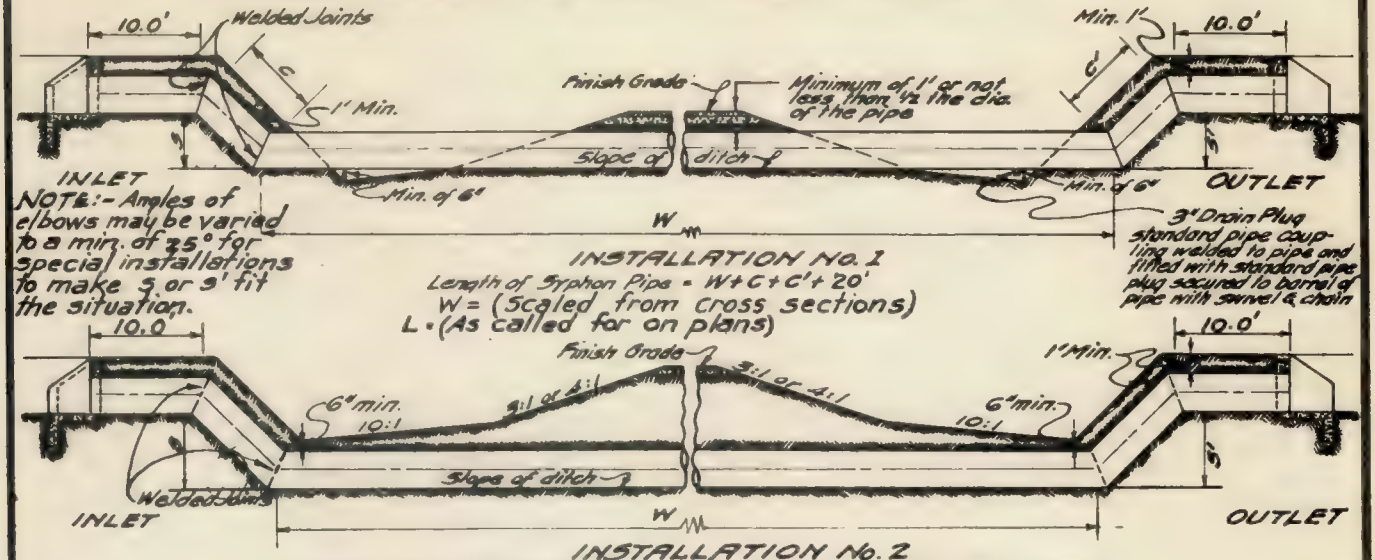
CULVERT			CUBIC YARDS CLASS "B" CONC.		DIMENSION TABLE				
DIA. "D"	AREA SQ. FT.		INLET	OUTLET	L	L'	A	B	H
18"	1.77		0.63	0.52	2'-6"	2'-2"	1'-3"	1'-3"	2'-6"
24"	3.14		0.85	0.68	3'-0"	2'-6"	1'-6"	1'-6"	3'-0"
30"	4.91		1.10	0.86	3'-6"	2'-10"	1'-9"	1'-9"	3'-6"
36"	7.07		1.37	1.06	4'-0"	3'-2"	2'-0"	2'-0"	4'-0"
42"	9.62		1.67	1.28	4'-6"	3'-6"	2'-3"	2'-3"	4'-6"
48"	12.57		2.01	1.52	5'-0"	3'-10"	2'-6"	2'-6"	5'-0"

Reinforcement steel as indicated to be included in the unit price bid for concrete.
Class "A" conc. can be substituted by the contractor with the approval of the Engineer at no additional cost to the state.

APPROVED JUN 1, 1946
R. A. Hillcoub
ADMINISTRATIVE AID

Montana State Highway Commission

CORRUGATED METAL PIPE SYPHON



NOTE:- Angles of elbows may be varied to a min. of 75° for special installations to make 3 or 5' fit the situation.

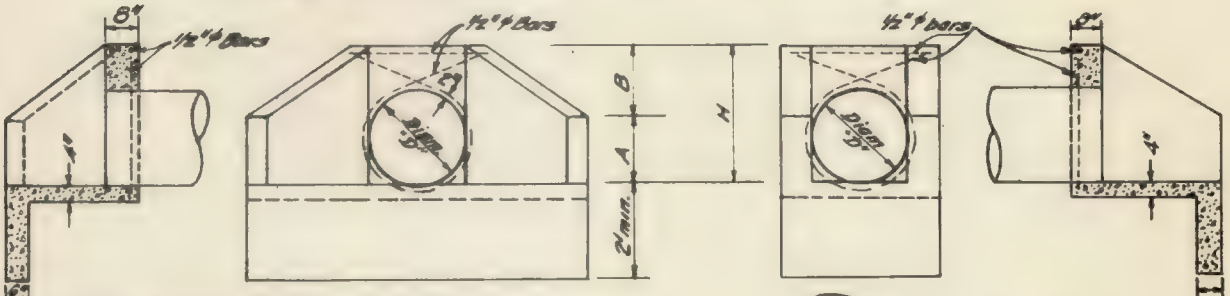
INSTALLATION No. 1

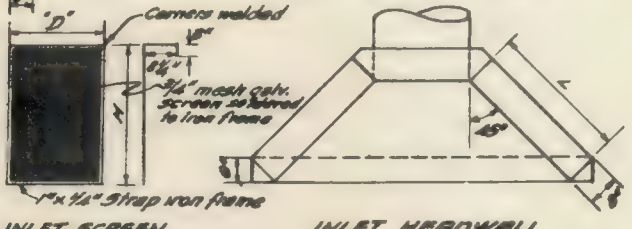
Length of Syphon Pipe = W+C+C'+20'
W = (Scaled from cross sections)
L = (As called for on plans)

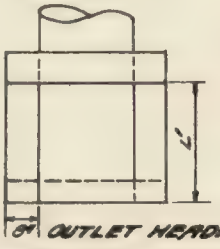
INSTALLATION No. 2

To be used where Installation No. 1 is not possible due to less than minimum 5-5' or less than minimum cover.

Payment for pipe to be made for length measured along ℄ of pipe







NOTE:- Do not use headwalls unless called for on plans.

INLET SCREEN (NOT TO BE USED UNLESS RECOMMENDED BY THE ENGINEER)

INLET HEADWALL

OUTLET HEADWALL

All exposed corners of concrete to be chamfered 1"
Reinforcing steel to be not less than 1½" to nearest face of concrete

INLET & OUTLET HEADWALLS

* SYPHON PIPE			CUBIC YARDS CLASS "B" CONC.		DIMENSION TABLE				
DIA-"D"	AREA SQ.FT.	MIN. C or C'	INLET	OUTLET	L	L'	A	B	H
18"	1.77	2.0	0.63	0.52	2'-6"	2'-2"	1'-3"	1'-3"	2'-6"
24"	3.14	2.0	0.85	0.68	3'-0"	2'-6"	1'-6"	1'-6"	3'-0"
30"	4.91	2.0	1.10	0.86	3'-6"	2'-10"	1'-9"	1'-9"	3'-6"
36"	7.07	2.0	1.37	1.06	4'-0"	3'-2"	2'-0"	2'-0"	4'-0"
42"	9.62	2.0	1.67	1.28	4'-6"	3'-6"	2'-3"	2'-3"	4'-6"
48"	12.57	2.0	2.01	1.52	5'-0"	3'-10"	2'-6"	2'-6"	5'-0"

* Syphon pipe to be corrugated metal, close riveted and soldered water-tight
Reinforcement steel as indicated to be included in the unit price bid for concrete
Maximum 5 or 5' - 10".
Or Reinf. Conc. Syphon pipe as called for in the Standard Specifications.

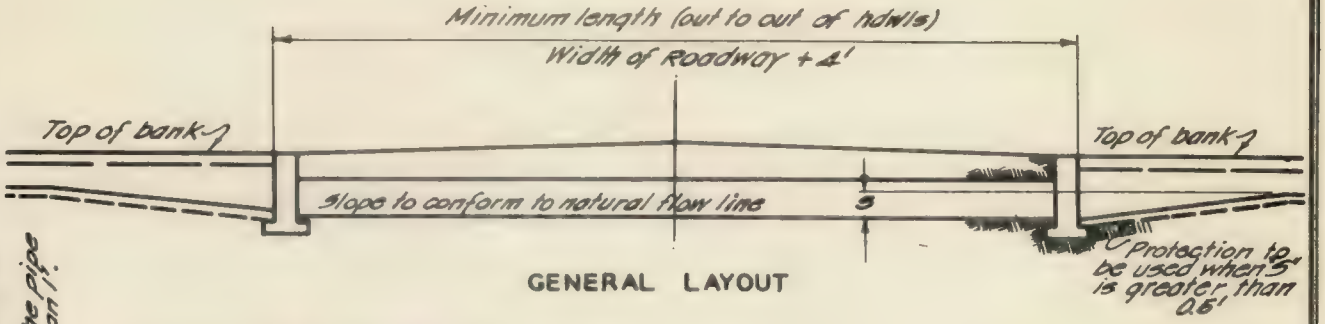
NOTE:- Class 'A' Conc. can be substituted by the Contractor with the approval of the Engr. at no additional cost to the State.

Montana State Highway Commission

APPROVED June 1-1946
R. H. Wellcomb
ADMINISTRATIVE AID

CONVERTED CULVERT SYPHON

(Use when "S" is 12" or less)

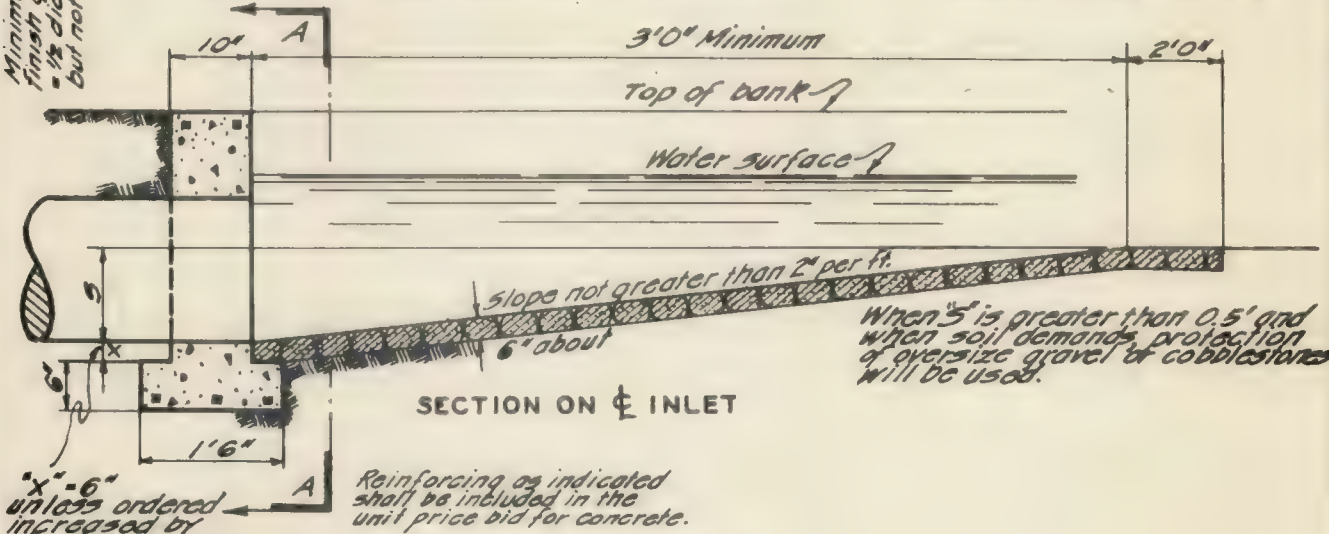

Minimum length (out to out of hdwls)
Width of Roadway + 4'
Top of bank
Top of bank
Slope to conform to natural flow line
S
Protection to be used when "S" is greater than 0.5'

GENERAL LAYOUT

Minimum cover to finish grade = ¼ diam. of the pipe but not less than 1'

Standard M6 Headwall, increase "H" as required to make flush with top of bank

All exposed corners of concrete to be chamfered 1"

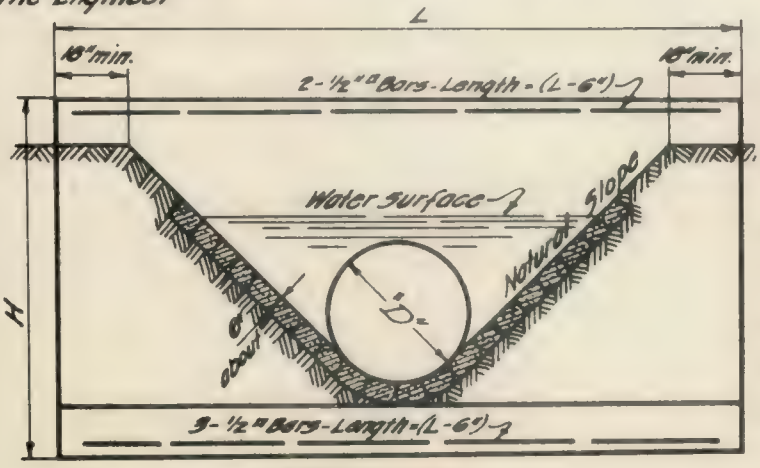


SECTION ON ℄ INLET

When "S" is greater than 0.5' and when soil demands protection of oversize gravel or cobblestones will be used.

"X" - 6" unless ordered increased by the Engineer

Reinforcing as indicated shall be included in the unit price bid for concrete.



SECTION A-A

Where "S" is greater than 0.5' or when soil demands, protection of oversize gravel or cobblestones will be used. Should the natural slope of ditch banks be such that the protection will not stand, use cement grout.

Diam. * of Pipe	"L"	Class "B" Concrete	
		Conc. in 2 M6 Hdwls. X = 6"	Conc. 2-Hdwls. for ¼ ft. Additional "H"
18"	6'0"	1.34	0.092
24"	8'0"	1.98	0.123
30"	10'0"	2.72	0.154
36"	12'0"	3.56	0.185

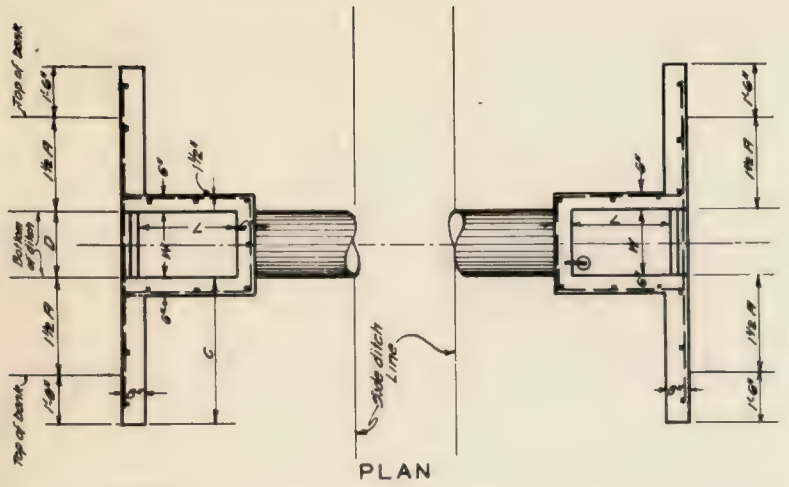
* Syphon pipe to be corrugated metal, close riveted and soldered water-tight. Or Reinf. Conc. syphon pipe as called for in the Standard Specifications.

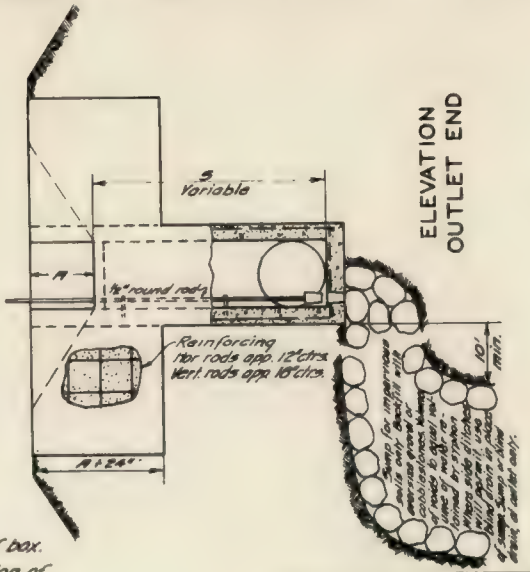
Approved JUN. 1, 1946
J. A. Hillesund
ADMINISTRATIVE AID

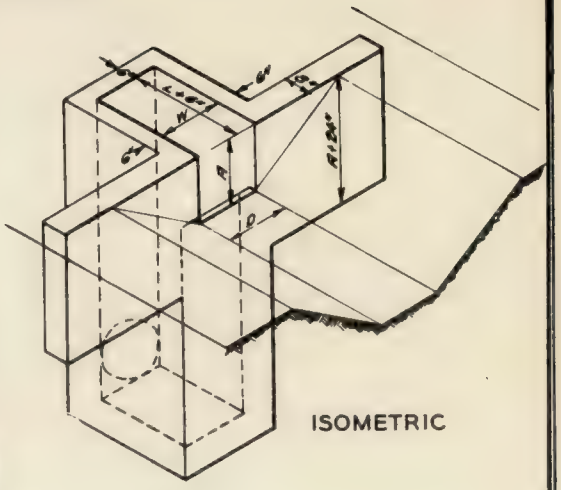
Montana State Highway Commission

37-M86

REINFORCED CONCRETE SYPHON





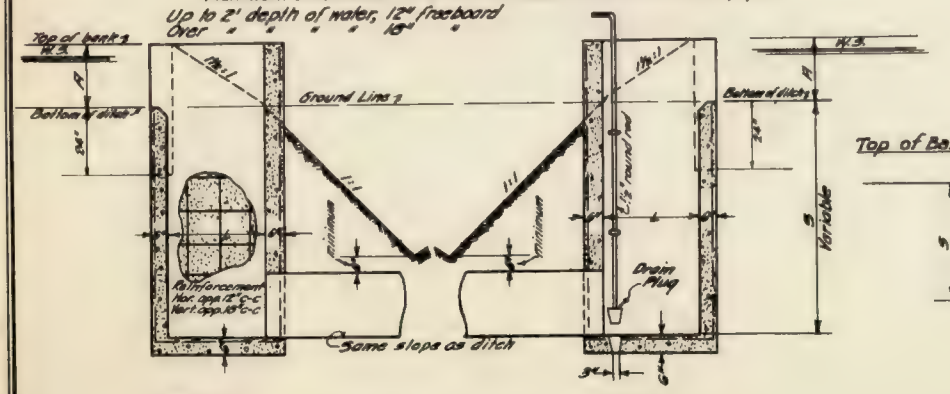


NOTES: 'W' minimum = 24"; above 24" 'W' = outside diameter of pipe or inside width of box.
'L' = 36" minimum to increase as necessary to make areas of cross section of box and well equal.
When 'S' exceeds 4', inside face of well to be reinforced the same as outside face. In no case shall 'S' exceed 6'. Reinforce with ½" ø steel as shown.
Concrete = Class 'A'.
All exposed corners of concrete to be chamfered 1".
Maximum size barrel 4'x6' box; minimum size barrel 18" pipe

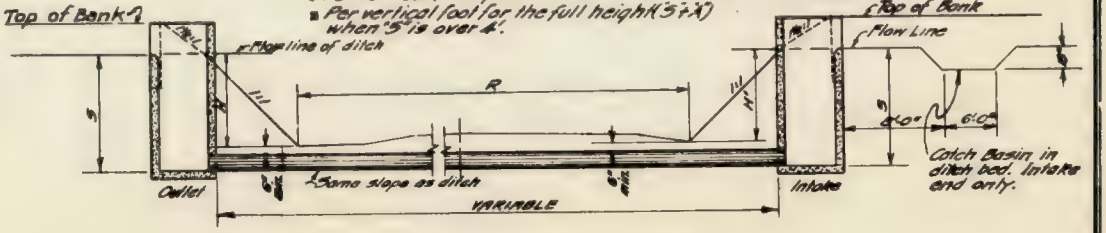
INTAKE + OUTLET

SIZE PIPE	DIMENSIONS S	L	W	A	C	QUANTITIES (INTAKE + OUTLET) CU. YDS. CLASS 'A' CONC.	LBS. ½" ø STEEL	PER VERT. FT. OF BOX C.Y. CONC.	PER VERT. FT. OF BOX LBS. STL.	AREA PIPE SQ. FT.
18"	1'-6"	3'-0"	2'-0"	1'-11"	4'-4½"	3.25	276	0.44 *	39-71 *	1.77
24"	1'-6"	3'-0"	2'-0"	2'-7"	5'-4½"	4.16	325	0.44	39-71	3.14
30"	1'-6"	3'-0"	2'-6"	3'-0"	6'-0"	4.94	394	0.48	44-79	4.91
36"	1'-6"	3'-0"	3'-0"	3'-5"	6'-7½"	5.77	471	0.52	46-82	7.07

* Corrugated metal, close riveted and soldered water-tight. (Syphon Pipe)
* Per vertical foot of box when 'S' is over 1'-6" to 4' inclusive
* Per vertical foot for the full height (S + A) when 'S' is over 4'.



LONGITUDINAL SECTION



VERTICAL SECTION ON ℄ OF SYPHON

MINIMUM LENGTH OF PIPE NEEDED = R + H + H'

Berm may be left between Syphon wall and top of cut slope.

APPROVED JUN. 1, 1946
R. H. Willcomb
ADMINISTRATIVE AID

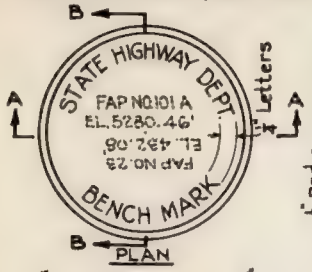
Montana State Highway Commission

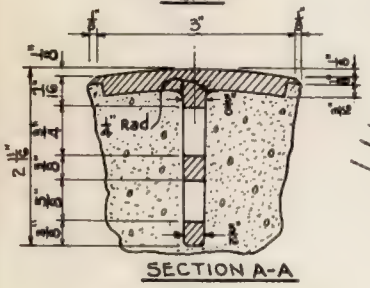
37-M86

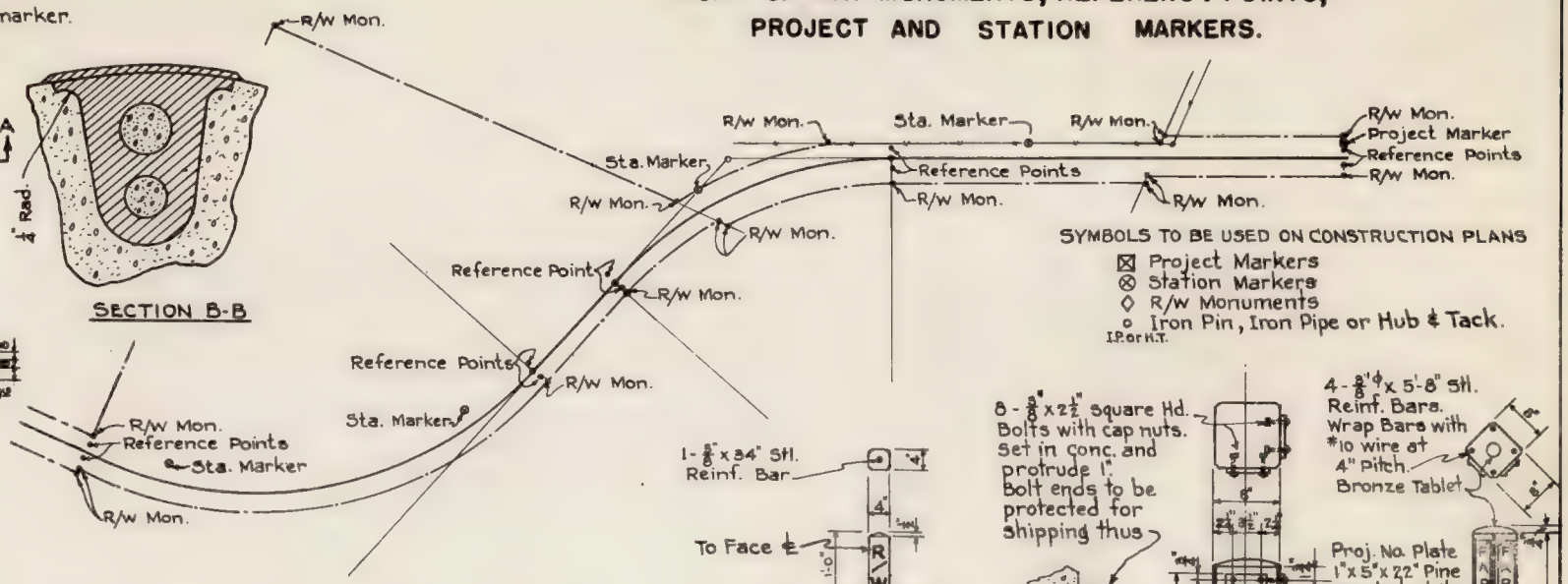
RIGHT OF WAY MONUMENTS, REFERENCE POINTS, PROJECT AND STATION MARKERS.

BRONZE TABLET

To be set in top of project marker.



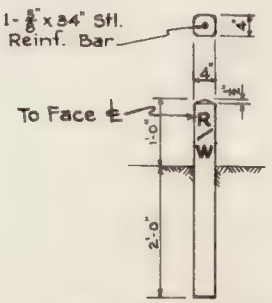




SYMBOLS TO BE USED ON CONSTRUCTION PLANS

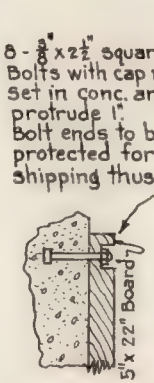
- ⊠ Project Markers
- ⊗ Station Markers
- ◇ R/w Monuments
- ○ Iron Pin, Iron Pipe or Hub & Tack.

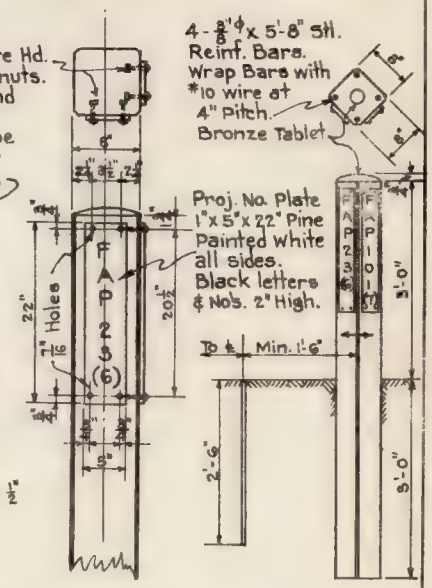
I.P. or H.T.

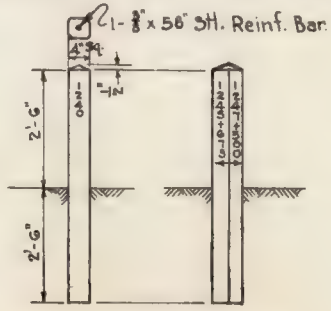


RIGHT OF WAY MONUMENT

¾" Max. Size Aggregate
Class "D" Conc. Rubbed finish on face. 4"x4" Sq.
⅝" x 34" Stl. reinforcing bar thru center.
Recessed letters 3" high. Corners chamfered ½"




4-⅝" x 5'-8" Stl. Reinf. Bars. Wrap Bars with #10 wire at 4" Pitch.
Bronze Tablet
Proj. No. Plate 1"x 5"x 22" Pine Painted white all sides. Black letters & No's. 2" High.
2½"
7" Holes
20½"
FAP 23 (6)
To ℄ Min. 1'-6"
2'-6"
5'-0"



STATION MARKERS

¾" Max. Size Aggregate
Class "D" Conc. Rubbed finish on face. 4"x4" Sq.
Recessed letters 1½" high.

PROJECT MARKER

Posts to be reinf. concrete Aggregate ¾ inch max. Class "D" Concrete. Corners chamfered ½". Project number Plate to be furnished & erected by State Forces. Series "D" letters & numerals to be used as per Std. alphabets published by Public Rds. Adm. 1945.

REFERENCE POINT

1" Iron pin. Another reference point to be set on opposite side of hwy.

GENERAL:- Reference points, Project and Station markers should be so placed that they will not be disturbed by maintenance operations. Project and Station markers should be plainly visible from the highway.

PROJECT MARKERS are to be set at the beginning & end of all lettered sections on either side of the highway.

REFERENCE POINTS are to be set on both sides of the ℄ at the beginning & end of all lettered sections, at all PCs, PTs and angle points and at such high points on long tangents as may be desirable. Except at project markers, they are to be at any convenient distance from the ℄.
After being driven a cross will be filed in the top to mark both the plus and the distance to the ℄.

STATION MARKERS are to be set opposite every tenth station and at important equations. Equations of less than 100' may be disregarded. Markers are to be set on the north or west side of the ℄ depending on the general direction of the route. Markers shall be set so as to be visible from highway ℄. (on R/w line if possible).

RIGHT OF WAY MONUMENTS will be set at all points where the width of the R/W changes and at PCs, PTs and at angle points. When it seems undesirable to use the concrete monuments as on lot or block lines in some parts of a town, concrete monuments will be omitted & iron pipes or pins will be placed by State Highway Dept. forces.

BRONZE TABLET. Exposed surfaces of the tablet are to be ground smooth. Letters are to be recessed 1/16 inch. Information on the tablet, indicated by pin lines, is to be stamped in the field by the engineering party after post is placed using ¾" letters.

NOTE:- R/W monuments not to be ordered by contractor until checked in field by the Engineer.
R/W monuments to be placed so that outside face of monument coincides with R/W ℄ line as purchased.

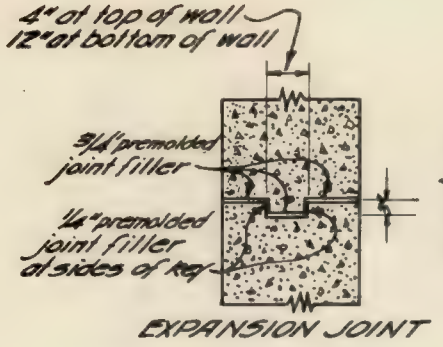
Montana State Highway Commission.

APPROVED JUN 1, 1946
P. St. Willcomb
ADMINISTRATIVE AID

REV. 6-1-48
REV. 1-27-47

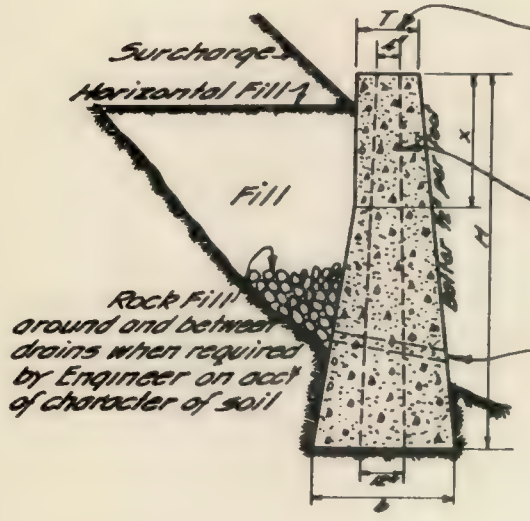
38-M1

CEMENT RUBBLE MASONRY OR CONCRETE RETAINING WALL



EXPANSION JOINT

Place expansion joint in all concrete walls over 60 ft. long. Place expansion joints from 30 ft. to 50 ft. c to c as directed by the engineer. Joints should be placed where there is a great change in height of wall.



Thickness of wall at top to be determined in field to fit conditions, in general; thickness to be not less than 12" and if serving as a curb or portion of a railing, thickness shall be not less than 18".

Key of expansion joint in concrete wall.

Weep holes to be provided where necessary

X = 2½T FOR HORIZONTAL FILL
X = 2 T FOR SURCHARGE
b = 0.4H FOR HORIZONTAL FILL
b = 0.55H FOR LIVE LOAD
b = 0.6 H FOR INCLINED SURCHARGE

~ NOTE ~

Maximum height of retaining walls built from these standards equals 15'-0".

Special plans are required for all walls over 15' in height.

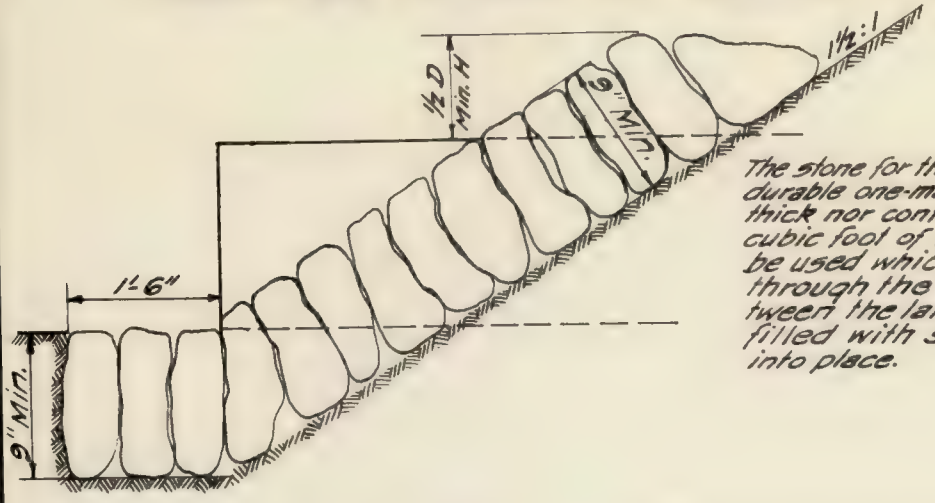
Concrete retaining wall to be Class "B" concrete.

For Cement Rubble Masonry See Standard Specifications

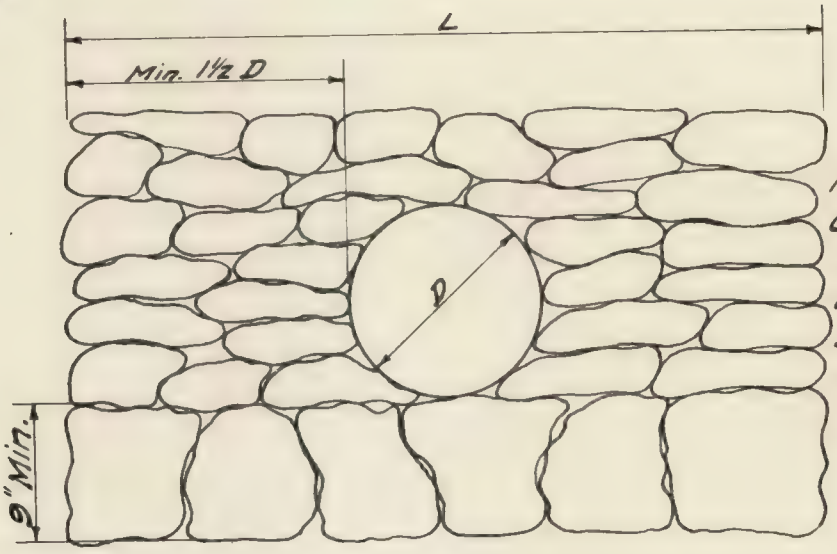
APPROVED JUN. 1, 1946
R. A. Hillcoat
ADMINISTRATIVE AID

Montana State Highway Commission.

GROUTED RIPRAP AT CULVERT ENDS



The stone for this work shall be sound durable one-man stone, not less than 3" thick nor containing less than one-half cubic foot of volume. No stone shall be used which does not extend through the revetment. Spaces between the larger stones shall be filled with spalls securely rammed into place.



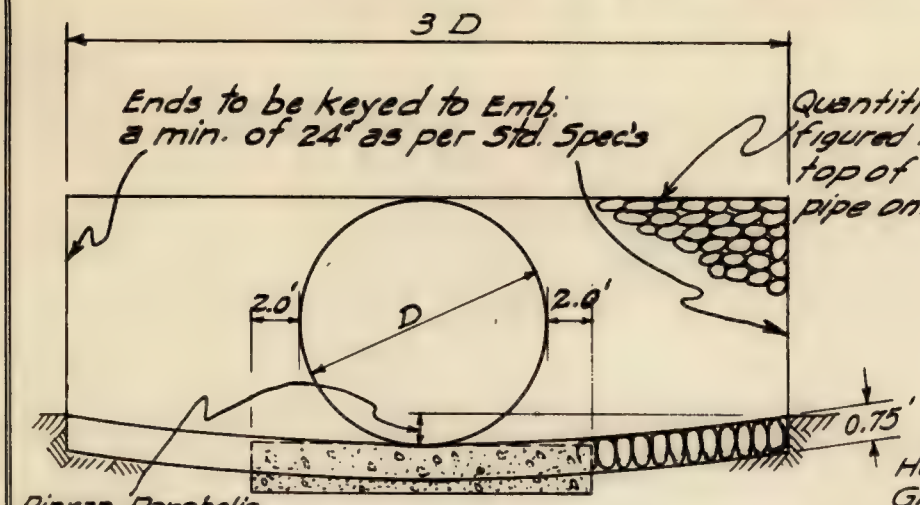
Keying of ends of riprap walls into embankment slopes, as per standard specifications, not required.

GROUTED RIPRAP					
DIMENSIONS			*SQUARE YARDS		
DIA. "D"	MIN. "L"	MIN. "H"	MIN. AT CULV. END	PER ADDED FOOT OF LENGTH	PER ADDED FOOT OF HEIGHT
24"	8'	1.0	5.51	0.77	0.200 X L.
30"	10'	1.25	8.20	0.92	0.200 X L.
36"	12'	1.5	11.39	1.07	0.200 X L.
42"	14'	1.75	15.13	1.22	0.200 X L.
48"	16'	2.0	19.38	1.37	0.200 X L.

* These quantities are for estimating only, therefore call for the closest even number of square yards.

APPROVED Jan. 1 1926
R. A. Wallace
ADMINISTRATIVE AID

GROUTED RIPRAP HEADWALLS FOR SECTIONAL PLATE PIPE CULVERTS



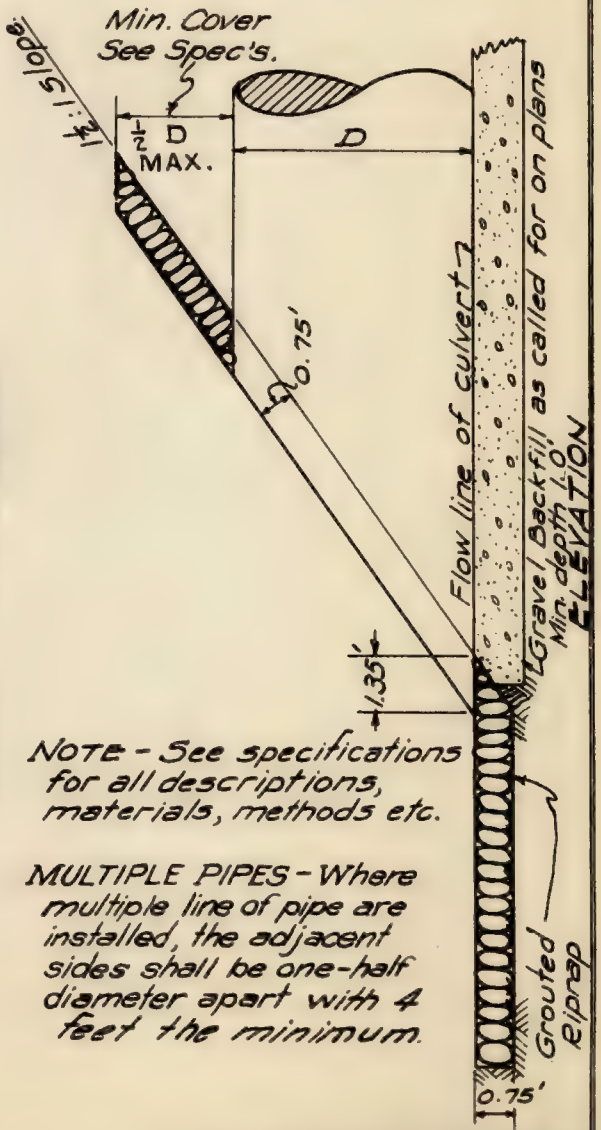
Riprap Parabolic Dish 0.1' Per 1.0' of Dia. of Pipe.

ELEVATION

QUANTITIES	
DIA. PIPE	SQ. YDS.
60"	40
75"	60
90"	85
105"	115
120"	150
135"	188
150"	231
165"	278
180"	331
195"	387
210"	449

Quantities figured for 2 Hdwls. & 1 apron for outlet. Grouted Riprap shall not be placed until the embankment has settled to a stable foundation.

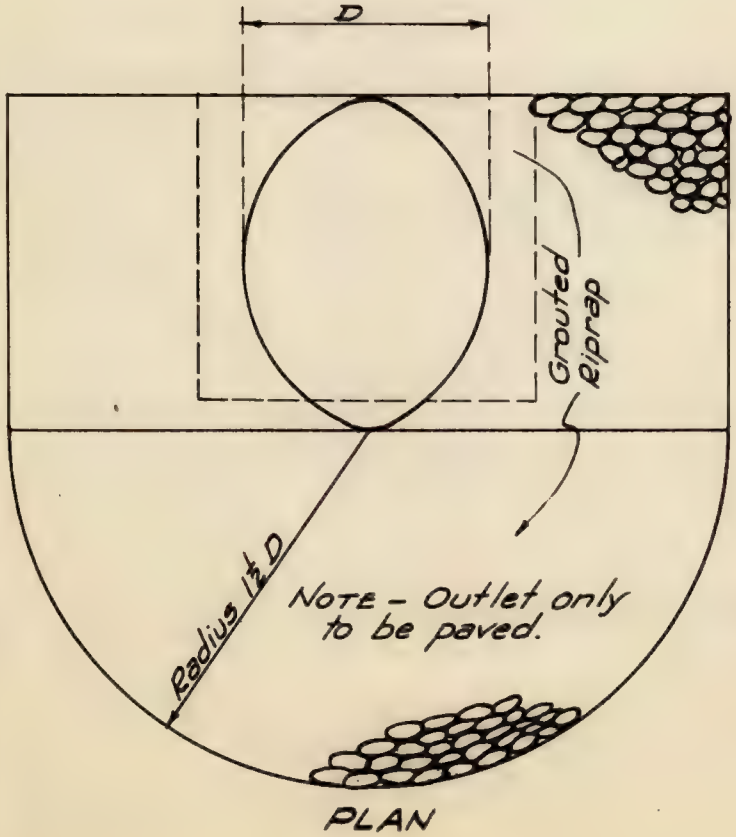
NOTE –
D = Dia. of pipe



ELEVATION

NOTE - See specifications for all descriptions, materials, methods etc.

MULTIPLE PIPES - Where multiple line of pipe are installed, the adjacent sides shall be one-half diameter apart with 4 feet the minimum.



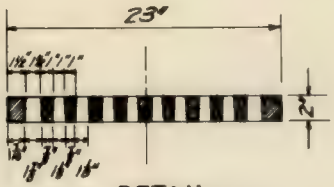
PLAN

Approved April 15, 1947
R. A. Hill
ADMINISTRATIVE AID

REV. 5-1-46

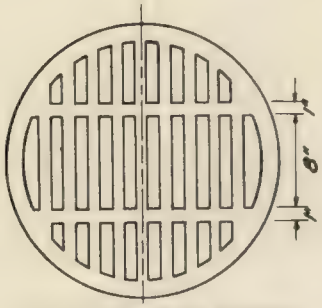
Montana State Highway Commission.

COMBINATION MANHOLE AND CATCH BASIN

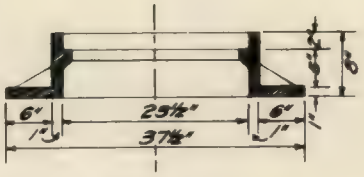


DETAIL
CATCH BASIN COVER

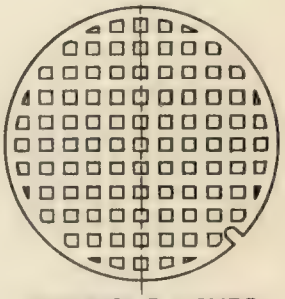
DETAIL
MANHOLE COVER



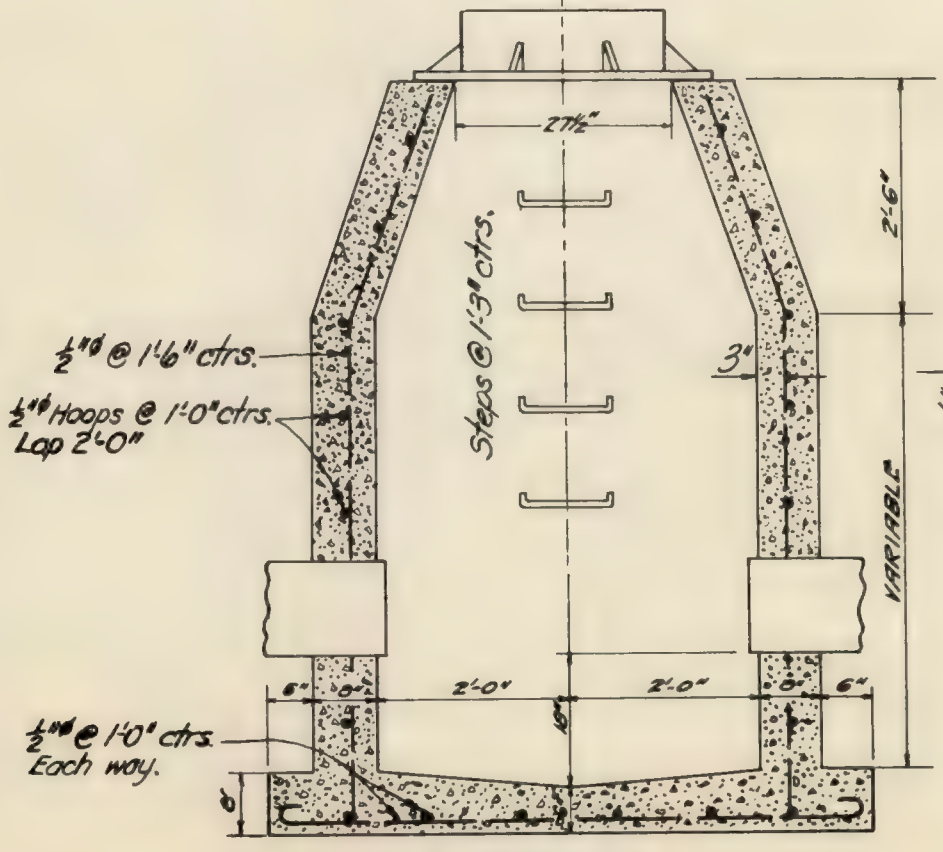
CATCH BASIN COVER
Scale 3/4"=1'



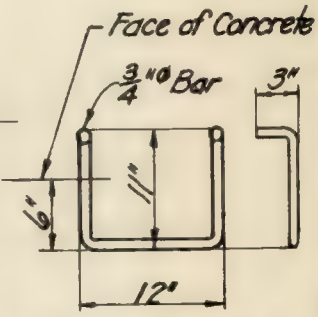
DETAIL
CASTING



MANHOLE COVER
Scale 3/4"=1'



COMBINATION MANHOLE AND CATCH BASIN
Scale: ½"=1'



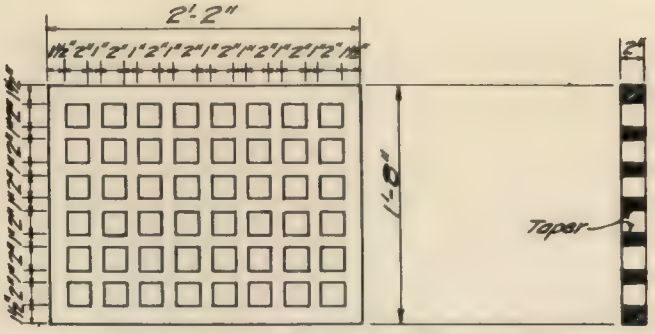
DETAIL OF STEP
Scale: ¾"=1'-0"

Note: Walls of manhole or catch basin may be of concrete or cement blocks
These details to serve as an example. Designers will design to specific conditions
All concrete to be Class 'A'

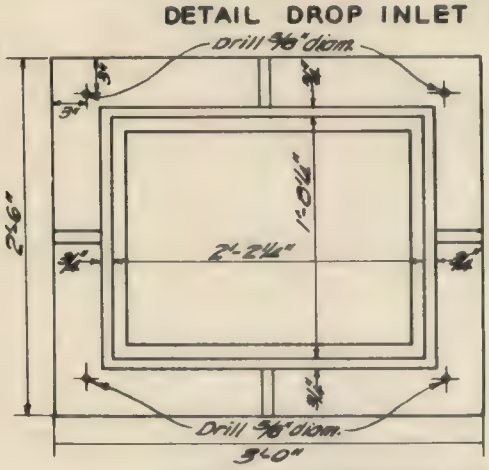
APPROVED JUN. 1, 1946
R. A. Hillcoub
ADMINISTRATIVE AID

Montana State Highway Commission.

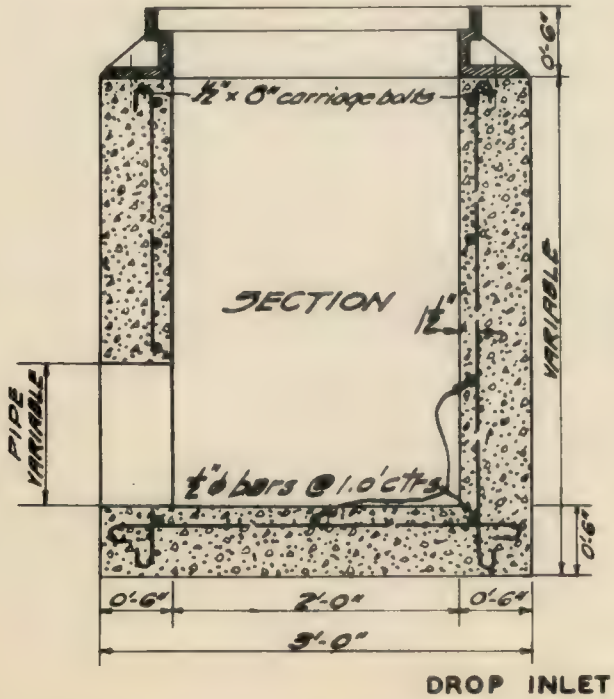
STANDARD DROP INLET



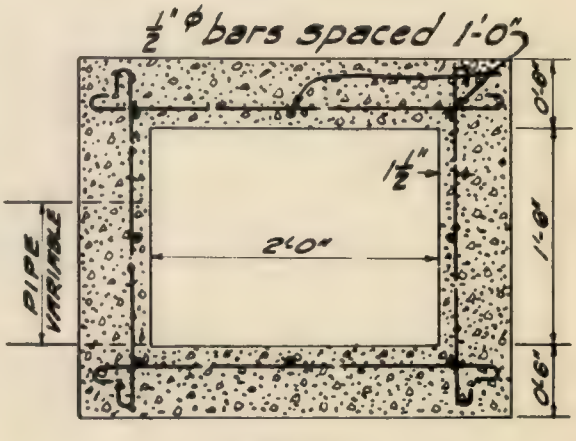
DETAIL DROP INLET COVER



DETAIL DROP INLET FRAME



DROP INLET BOX



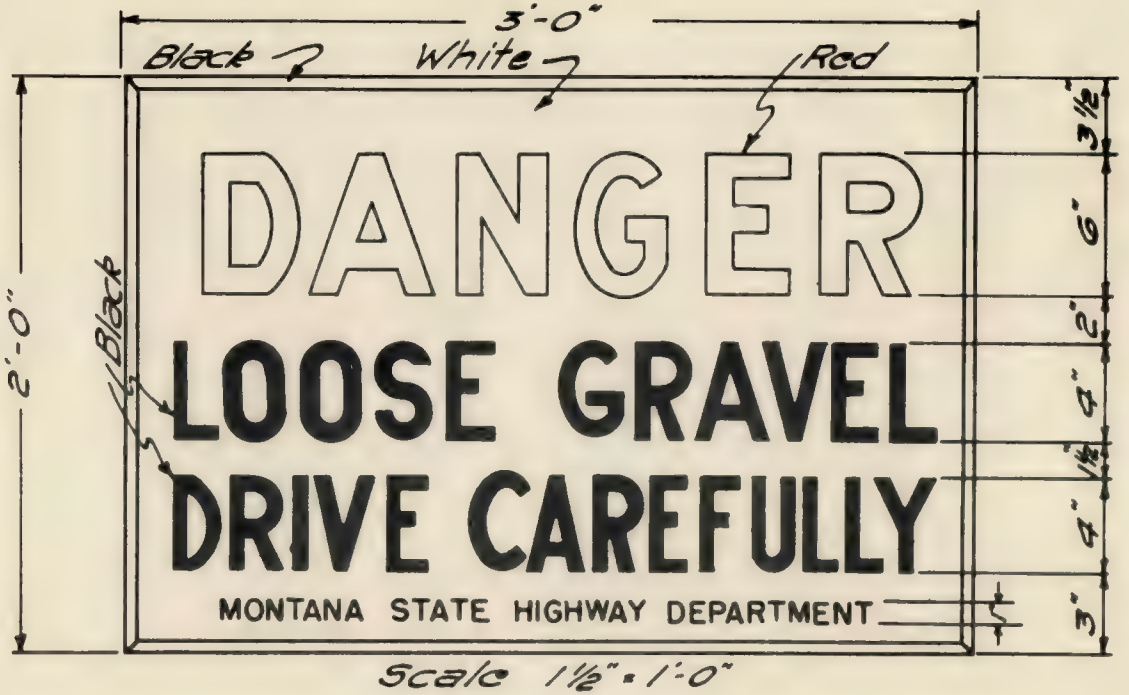
PLAN

Note: These details to serve as an example only. Designers will design to fit specific conditions.

Montana State Highway Commission.

APPROVED JUN. 1, 1946
R. H. Wilcomb
ADMINISTRATIVE AID

STANDARD CS 5



Sign to be painted or processed on white oil cloth or other suitable mat'l. Panel to have solid backing for sign and to be fastened to 4"x 4" post at each end set at least 3' in the ground and tamped. Center of sign to be 3.5' above road.

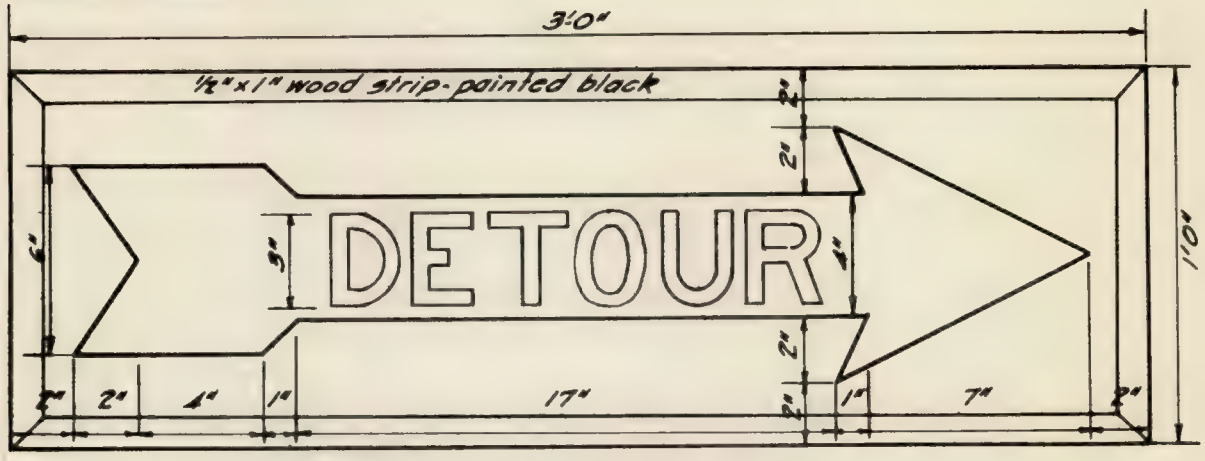
Montana State Highway Commission

APPROVED JUN. 1, 1946
STATE ENGINEER
ADMINISTRATIVE AID

44-CS5

STANDARD CS 4

Background- Yellow
Arrow - Black
Letters - Yellow



ARROW FOR DETOUR RIGHT

(Reverse arrow for detour left)

Sign to be painted or processed on yellow oil cloth or other suitable mat'l. Panel to have solid backing for sign and to be fastened to a 4"x4" post set at least 3' in the ground and tamped. Center of sign to be 4.0' above ground. When used with "Road Closed" sign, Detour arrow to be placed above.

Scale 2" = 1'-0"

Montana State Highway Commission

Approved JUN. 1, 1946.
T. A. Willcomb
ADMINISTRATIVE AID

STANDARD CS 7

Scale 1 1/2" = 1'-0"

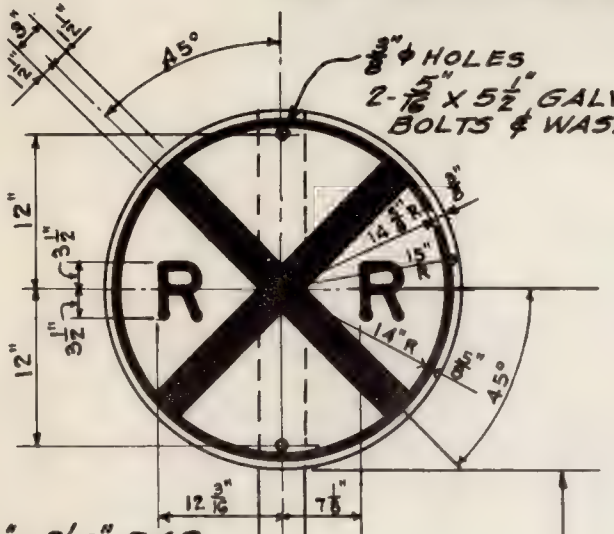
Sign to be painted or processed on white oil cloth or other suitable mat'l. Panel to have solid backing for sign and to be fastened to 4"x4" post at each end set at least 3' in the ground and tamped. Center of sign to be 3.5' above road.

Montana State Highway Commission

APPROVED JUN. 1, 1946
S. H. Williams
ADMINISTRATIVE AID

46-CS7

REFLECTORIZED R.R. ADVANCE WARNING SIGN



4"x4"x 8'-0" S4S
NO. 1 COMMON FIR OR LARCH POST PAINTED 3 COATS WHITE PAINT

2'-6"

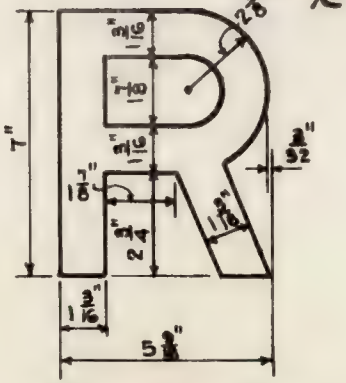
LEVEL OF HWY.

3'-0'

R.R. ADVANCE WARNING SIGN SHALL BE MADE OF 16 GAUGE SHEET STEEL & SHALL HAVE EITHER A SYNTHETIC ENAMEL OR VITREOUS ENAMEL FINISH.

R.R. ADVANCE WARNING SIGN SHALL BE PLACED NOT LESS THAN 6' NOR MORE THAN 10' FROM THE EDGE OF PAVEMENT OR TRAVELED WAY WITH THE LOWEST EDGE OF SIGN 2½' ABOVE THE ROAD SURFACE AND AT A MIN. OF 100' AND A MAX. OF 500' FROM THE CROSSING AS DIRECTED BY THE ENGINEER.

BACKGROUND – HIGHWAY YELLOW.
BORDER, SYMBOL, AND LETTERING - BLACK.
REFLECTORIZED BY REFLECTOR BUTTONS IN SYMBOL AND LETTERS, OR BY "REFLECTING COATING" BACKGROUND.



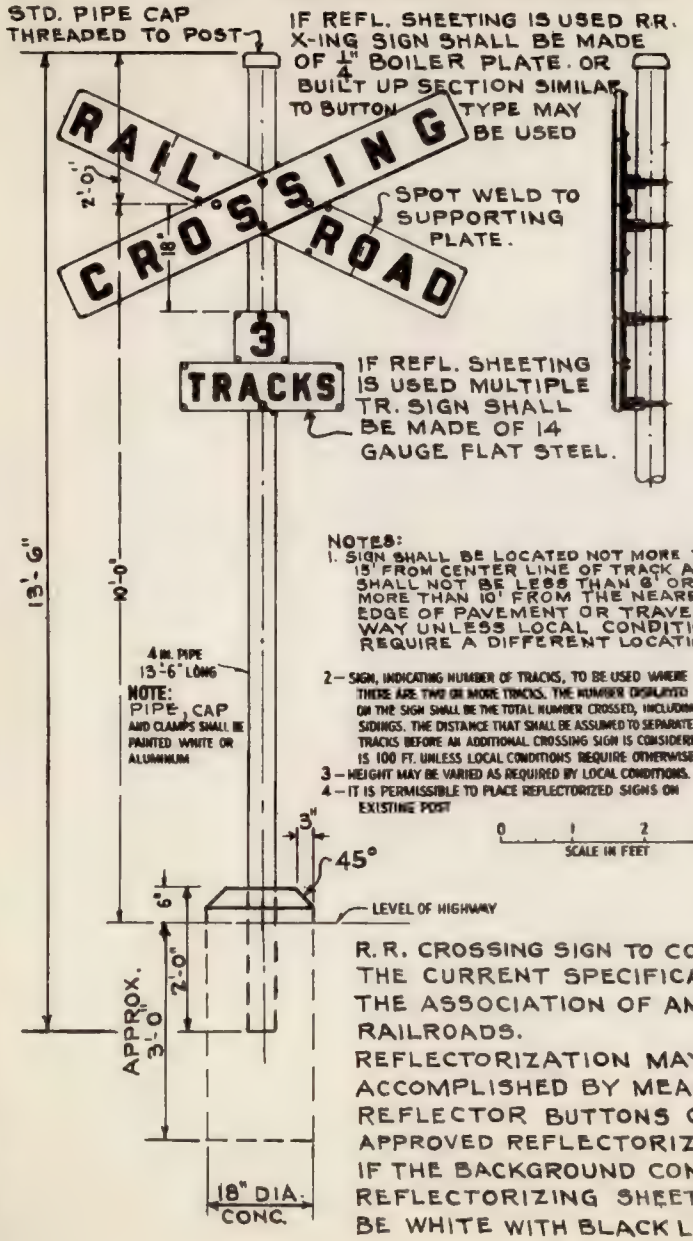
DETAIL OF LETTER

APPROVED 3-1-49
STATE HWY. ENGINEER.

Montana State Highway Commission.

47-ECS-1

50° REFLECTORIZED R.R. CROSSING PROTECTIVE SIGN

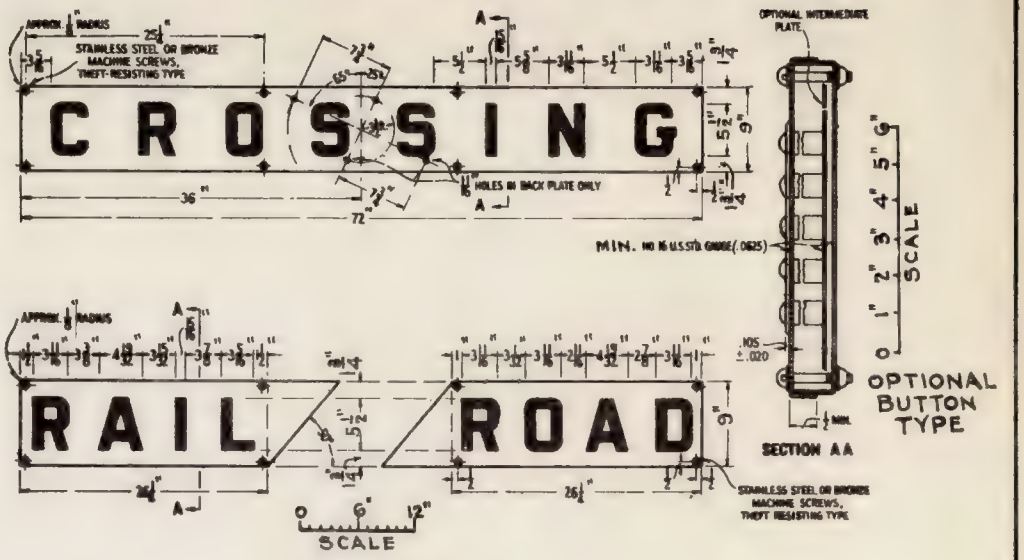

STD. PIPE CAP THREADED TO POST
IF REFL. SHEETING IS USED RR. X-ING SIGN SHALL BE MADE OF 1/4" BOILER PLATE. OR BUILT UP SECTION SIMILAR TO BUTTON TYPE MAY BE USED
RAIL ROAD CROSSING
SPOT WELD TO SUPPORTING PLATE.
3
TRACKS
IF REFL. SHEETING IS USED MULTIPLE TR. SIGN SHALL BE MADE OF 14 GAUGE FLAT STEEL.
18"
2'-0"
13'-9"
10'-0"
4 IN. PIPE 13'-6" LONG
NOTE: PIPE, CAP AND CLAMPS SHALL BE PAINTED WHITE OR ALUMINUM
3"
45°
6"
LEVEL OF HIGHWAY
APPROX. 3'-0"
2'-0"
18" DIA. CONC.

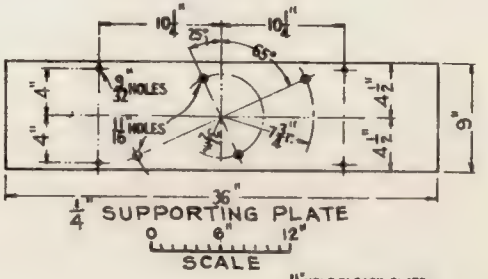
NOTES:

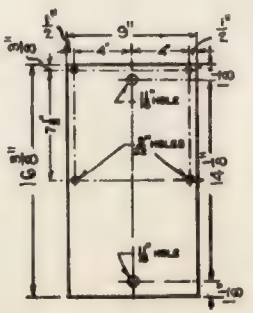
1. SIGN SHALL BE LOCATED NOT MORE THAN 15' FROM CENTER LINE OF TRACK AND SHALL NOT BE LESS THAN 6' OR MORE THAN 10' FROM THE NEAREST EDGE OF PAVEMENT OR TRAVELED WAY UNLESS LOCAL CONDITIONS REQUIRE A DIFFERENT LOCATION.
2. — SIGN, INDICATING NUMBER OF TRACKS, TO BE USED WHERE THERE ARE TWO OR MORE TRACKS. THE NUMBER DISPLAYED ON THE SIGN SHALL BE THE TOTAL NUMBER CROSSED, INCLUDING SIDINGS. THE DISTANCE THAT SHALL BE ASSUMED TO SEPARATE TRACKS BEFORE AN ADDITIONAL CROSSING SIGN IS CONSIDERED IS 100 FT. UNLESS LOCAL CONDITIONS REQUIRE OTHERWISE.
3. — HEIGHT MAY BE VARIED AS REQUIRED BY LOCAL CONDITIONS.
4. — IT IS PERMISSIBLE TO PLACE REFLECTORIZED SIGNS ON EXISTING POST

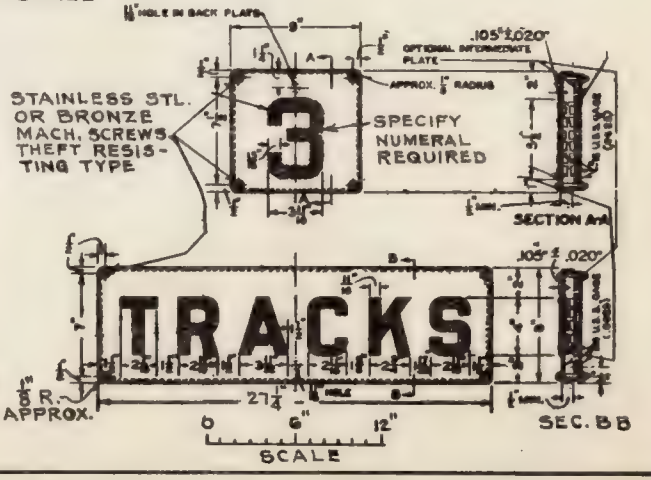
SCALE IN FEET 0 1 2 3

R. R. CROSSING SIGN TO CONFORM TO THE CURRENT SPECIFICATIONS OF THE ASSOCIATION OF AMERICAN RAILROADS.
REFLECTORIZATION MAY BE ACCOMPLISHED BY MEANS OF REFLECTOR BUTTONS OR APPROVED REFLECTORIZING SHEETING.
IF THE BACKGROUND CONSISTS OF REFLECTORIZING SHEETING IT SHALL BE WHITE WITH BLACK LETTERS.


CROSSING
RAIL ROAD
STAINLESS STEEL OR BRONZE MACHINE SCREWS, THEFT-RESISTING TYPE
HOLES IN BACK PLATE ONLY
OPTIONAL INTERMEDIATE PLATE
SECTION AA
OPTIONAL BUTTON TYPE
SCALE 0 1" 2" 3" 4" 5" 6"
SCALE 0 6" 12"





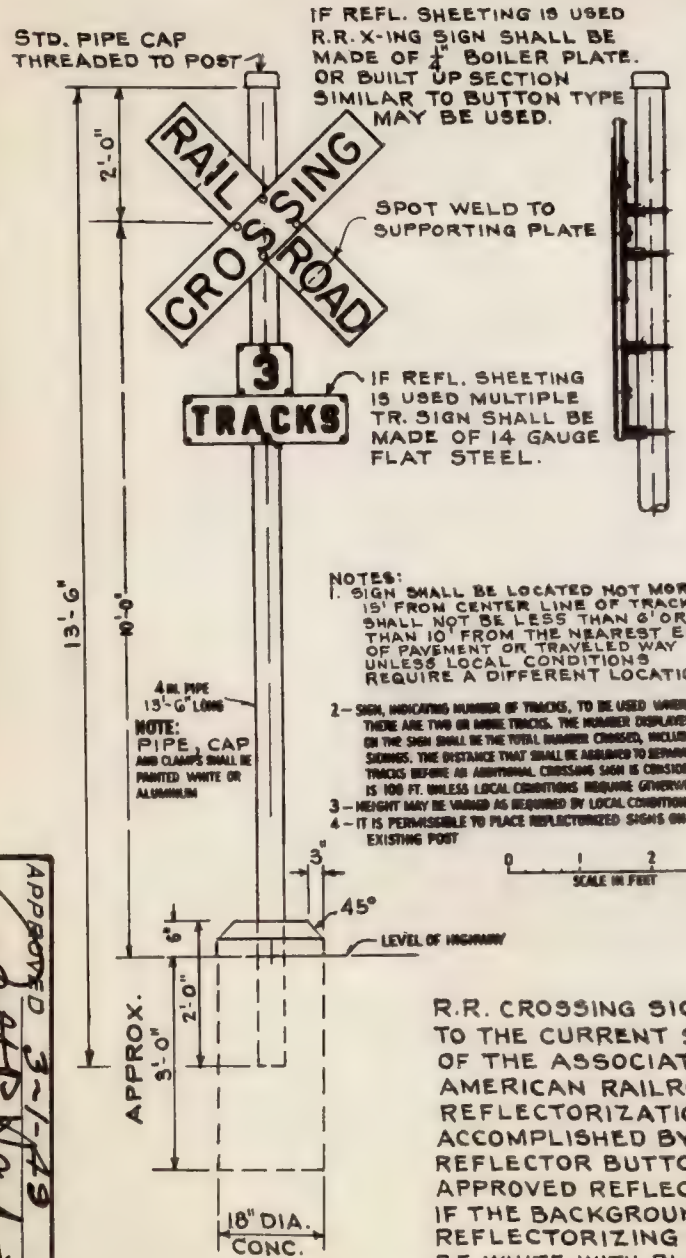


APPROVED
[signature]
3-1-49
STATE HWY. ENGINEER

Montana State Highway Commission.

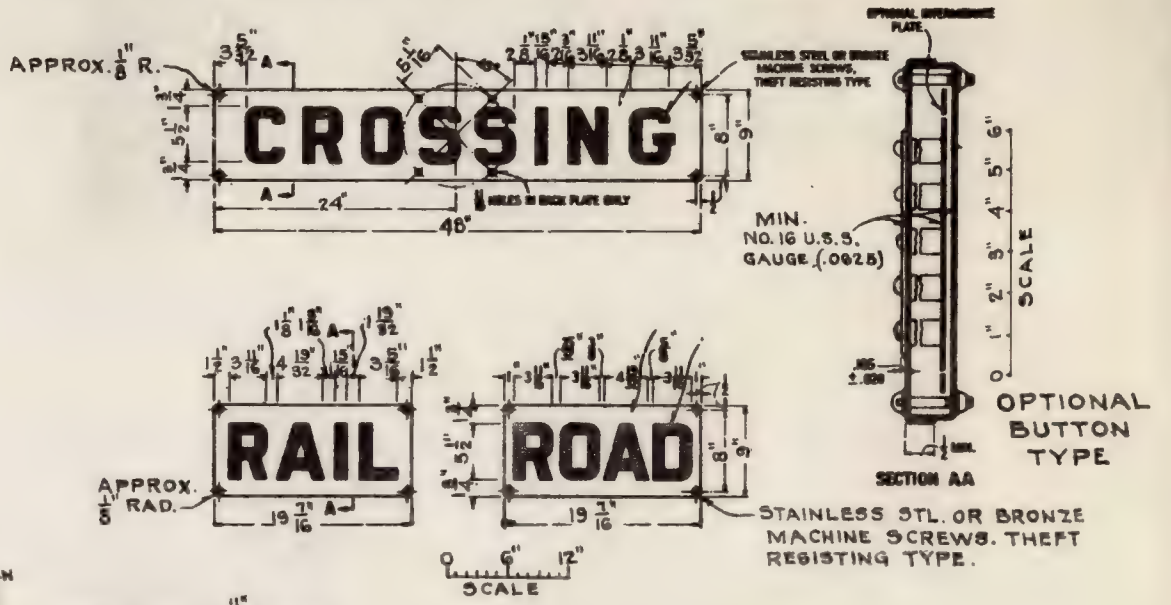
47-RCS-2

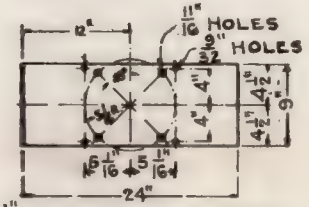
90° REFLECTORIZED R.R. CROSSING PROTECTIVE SIGN

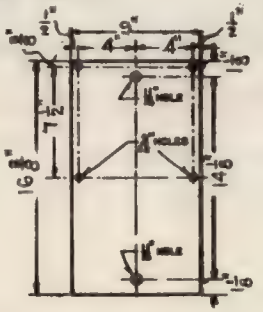

STD. PIPE CAP THREADED TO POST
IF REFL. SHEETING IS USED R.R.X-ING SIGN SHALL BE MADE OF ¼" BOILER PLATE. OR BUILT UP SECTION SIMILAR TO BUTTON TYPE MAY BE USED.
RAIL ROAD CROSSING
SPOT WELD TO SUPPORTING PLATE
3 TRACKS
IF REFL. SHEETING IS USED MULTIPLE TR. SIGN SHALL BE MADE OF 14 GAUGE FLAT STEEL.
2'-0"
13'-9"
8'-0"
4 in. PIPE 15'-6" LONG
NOTE: PIPE, CAP AND CLAMPS SHALL BE PAINTED WHITE OR ALUMINUM
3"
45°
6"
LEVEL OF HIGHWAY
APPROX. 3'-0"
2'-0"
18" DIA. CONC.

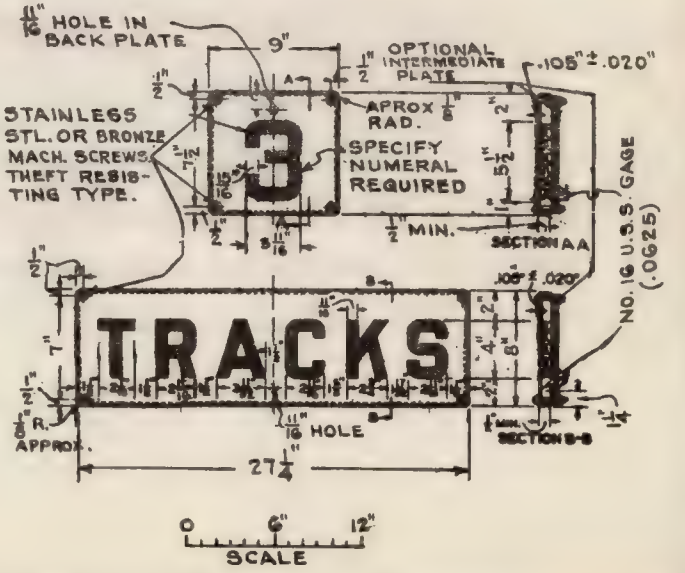
NOTES:
1. SIGN SHALL BE LOCATED NOT MORE THAN 15' FROM CENTER LINE OF TRACK AND SHALL NOT BE LESS THAN 6' OR MORE THAN 10' FROM THE NEAREST EDGE OF PAVEMENT OR TRAVELED WAY UNLESS LOCAL CONDITIONS REQUIRE A DIFFERENT LOCATION.
2. SIGN, INDICATING NUMBER OF TRACKS, TO BE USED WHERE THERE ARE TWO OR MORE TRACKS. THE NUMBER DISPLAYED ON THE SIGN SHALL BE THE TOTAL NUMBER CROSSED, INCLUDING SIDINGS. THE DISTANCE THAT SHALL BE ASSUMED TO SEPARATE TRACKS BEFORE AN ADDITIONAL CROSSING SIGN IS CONSIDERED IS 100 FT. UNLESS LOCAL CONDITIONS REQUIRE OTHERWISE.
3. HEIGHT MAY BE VARIED AS REQUIRED BY LOCAL CONDITIONS.
4. IT IS PERMISSIBLE TO PLACE REFLECTORIZED SIGNS ON EXISTING POST

0 1 2 3 SCALE IN FEET









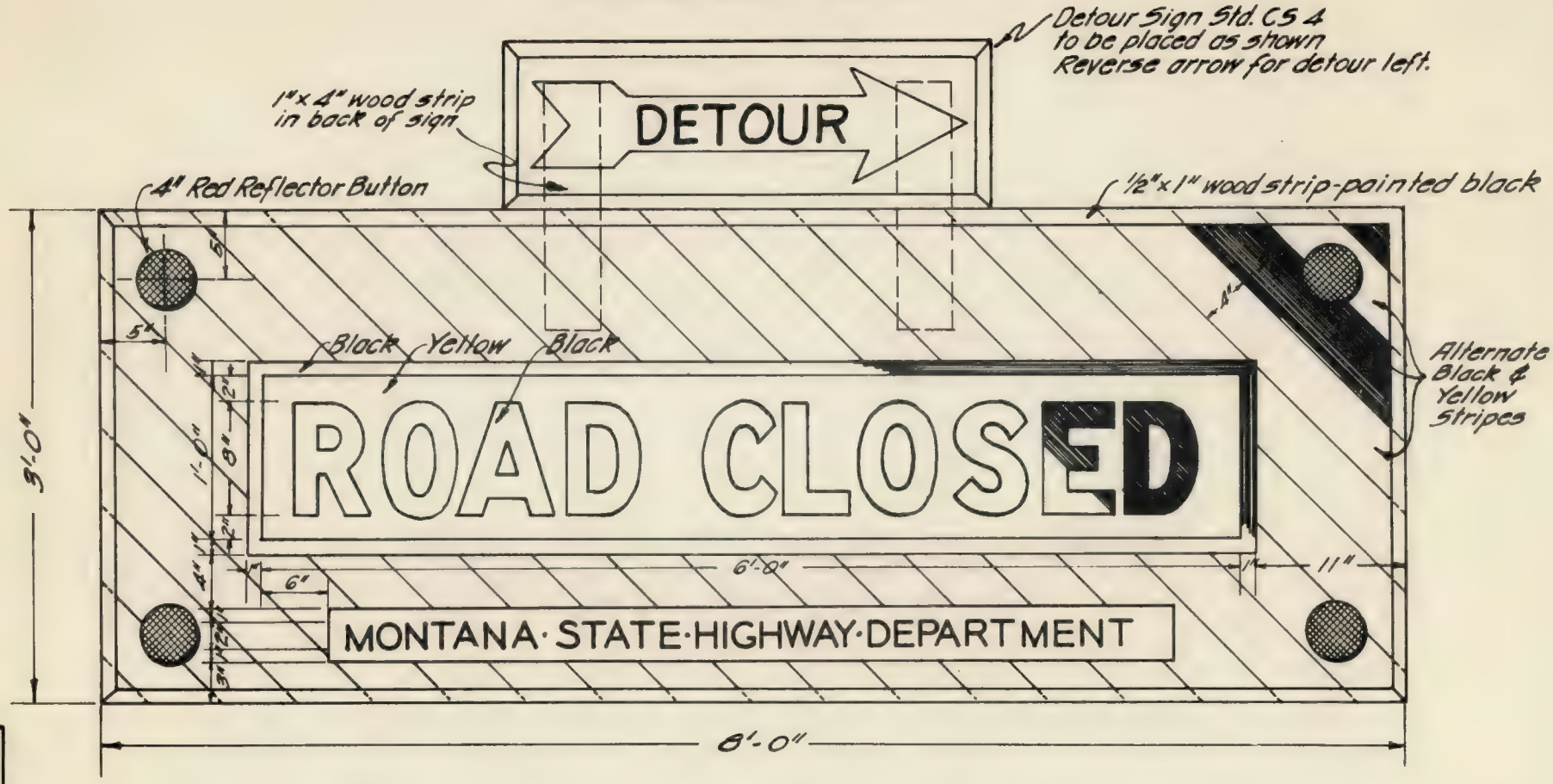
R.R. CROSSING SIGN TO CONFORM TO THE CURRENT SPECIFICATIONS OF THE ASSOCIATION OF AMERICAN RAILROADS. REFLECTORIZATION MAY BE ACCOMPLISHED BY MEANS OF REFLECTOR BUTTONS OR APPROVED REFLECTORIZING SHTG. IF THE BACKGROUND CONSISTS OF REFLECTORIZING SHEETING IT SHALL BE WHITE WITH BLACK LETTERS.

APPROVED 3-1-49
STATE HWY. ENGINEER

Montana State Highway Commission

47-RCS-3

STANDARD CS 2



Sign to be painted or processed on yellow oil cloth or other suitable material. Panel to have solid backing for sign and to be fastened securely to 4"x 4" post at each end set at least 3' in the ground and tamped. Center of sign to be 3.5' above road.

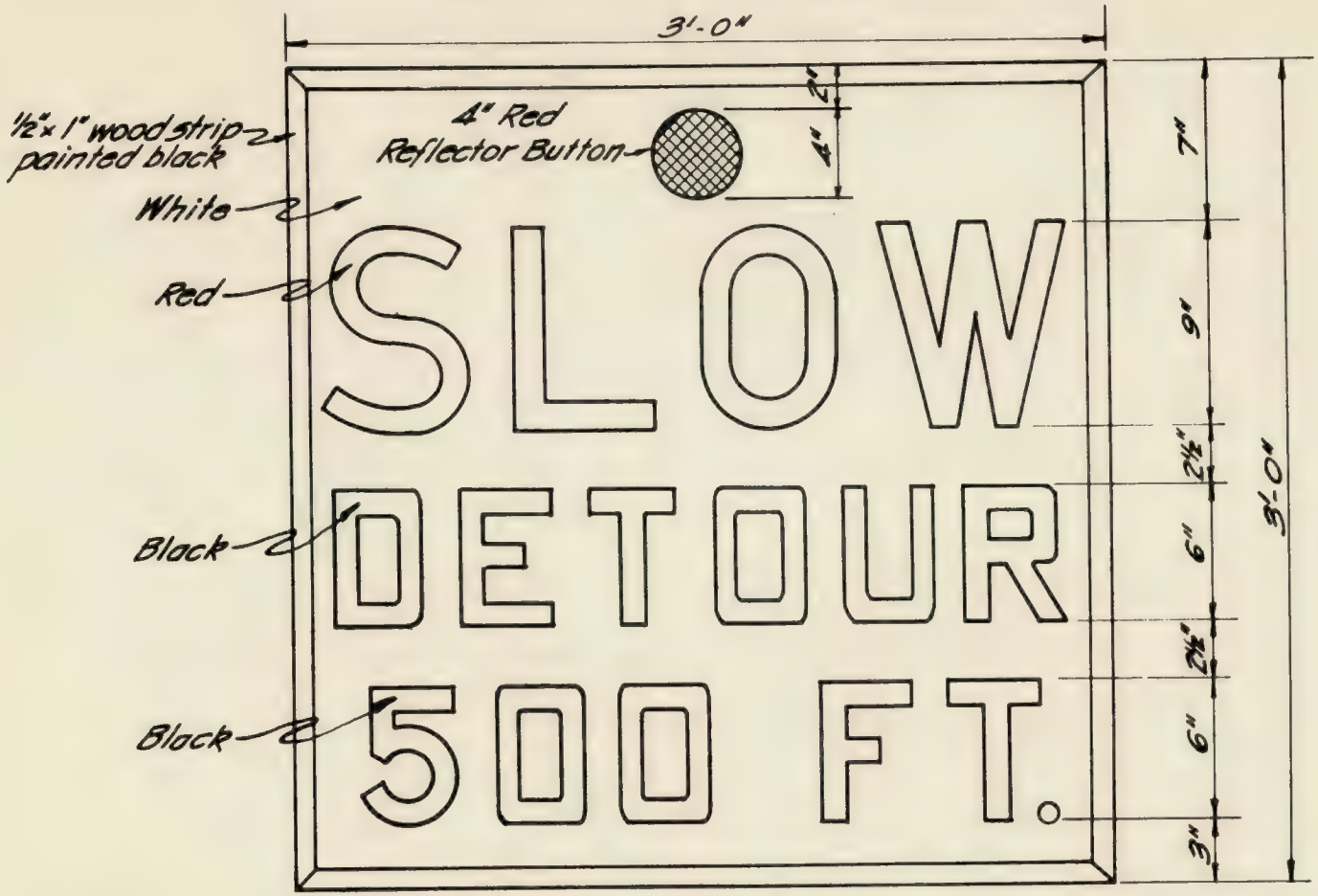
Scale 1"=1'-0"

Montana State Highway Commission

Approved JUN. 1, 1946.
Robt. Millcoul
ADMINISTRATIVE AID

48-CS2

STANDARD CS 3



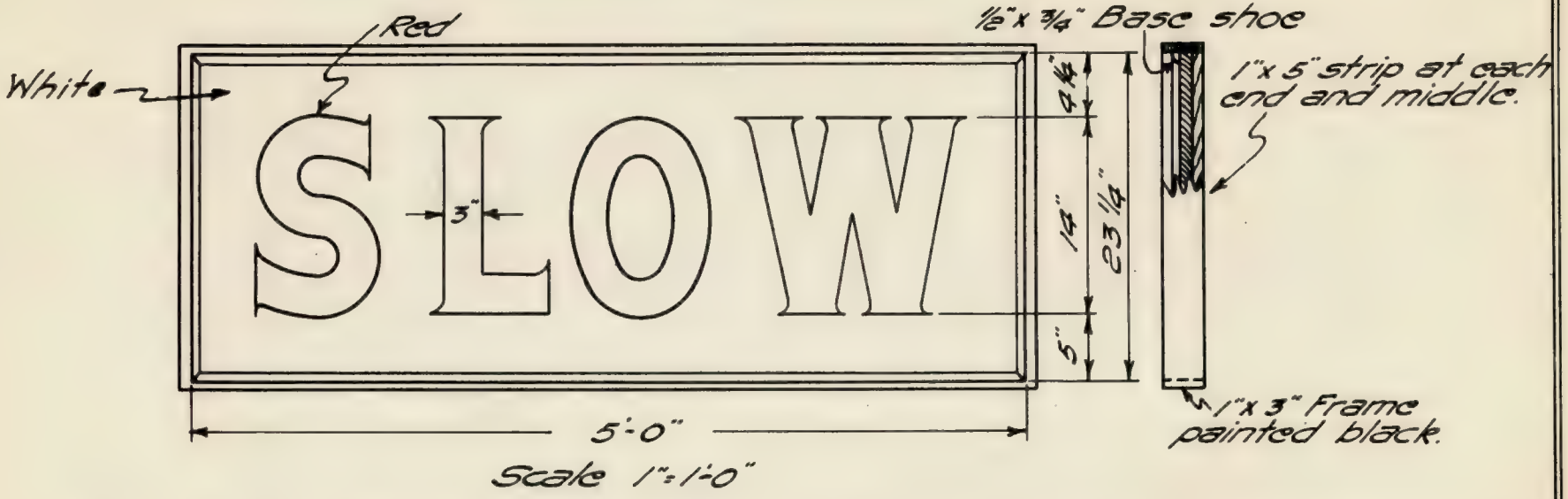
Sign to be painted or processed on white oil cloth or other suitable material
Panel to have solid backing for sign and to be fastened securely to 4"x 4"
post set at least 3' in ground and tamped. Center of sign to be 3.5' above ground.
Scale $1\frac{1}{2}" = 1'-0"$

Montana State Highway Commission

Approved JUN 1 1946
R.H. Willcomb
ADMINISTRATIVE AID

49-CS3

STANDARD CS 6



Scale 1" = 1'-0"

Sign to be painted or processed on white oil cloth or other suitable mat'l. Panel to have solid backing for sign and to be fastened securely to 4" x 4" post at each end set at least 3' in the ground and tamped. Center of sign to be 3.5' above road.

Montana State Highway Commission

APPROVED JUN. 1, 1946
C. M. Wilcox
ADMINISTRATIVE AID

50-CS6

STANDARD CS 1

Sign to be painted or processed on white oil cloth or other suitable material. Panel to have solid backing for sign and to be fastened to 4"x4" post at each end set at least 3' in the ground and tamped. Center of sign to be 3.5' above road.

Scale 1" = 1'-0"

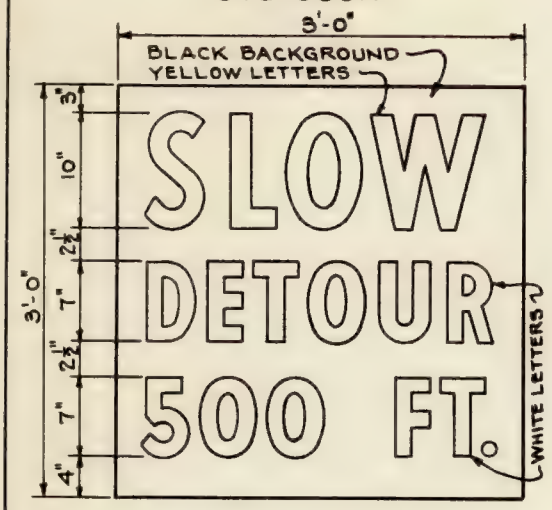
Montana State Highway Commission

Approved Jun. 1, 1946
R.H. Hillcoat
ADMINISTRATIVE AID

CS1-CS1

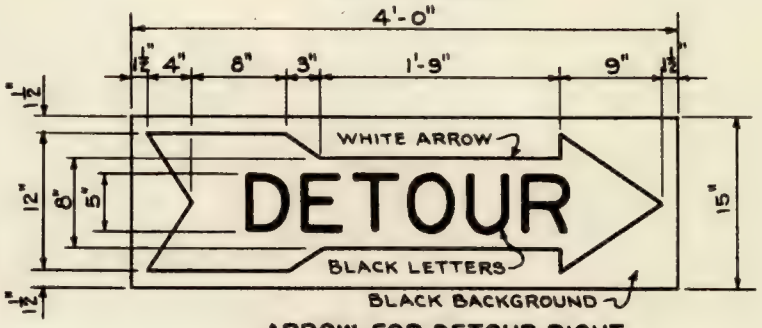
REFLECTORIZED CONSTRUCTION SIGNS

STD. CS3R



SCALE 1" = 1'-0"

STD. CS4R

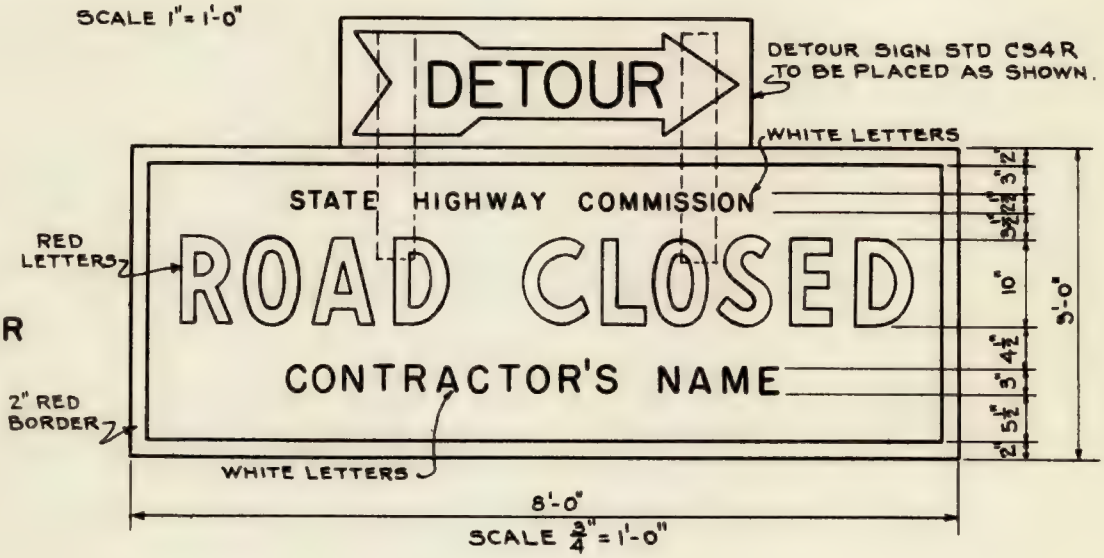


ARROW FOR DETOUR RIGHT

USE WITH REVERSE ARROW FOR DETOUR LEFT.

SCALE 1" = 1'-0"

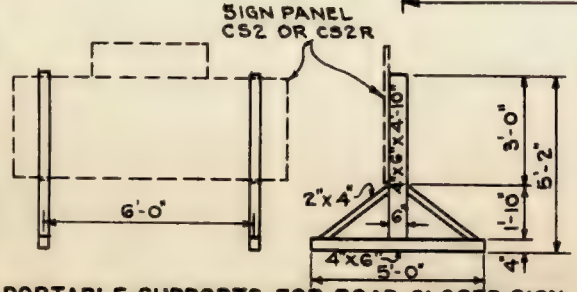
STD. CS2R



SCALE ¾" = 1'-0"

STD CS1R

SCALE ¾" = 1'-0"



PORTABLE SUPPORTS FOR ROAD CLOSED SIGN

SCALE 1/4" = 1'-0"

NOTE:- SIGNS TO BE FURNISHED AND ERECTED BY THE CONTRACTOR. SIGNS TO BE CONSTRUCTED OF ¾" WATERPROOF PLYWOOD OR OTHER MATERIAL THAT WILL SATISFACTORILY WITHSTAND THE WEATHER. EITHER THE BACKGROUND OR LETTERS MAY BE REFLECTORIZED. SIGNS TO BE FASTENED SECURELY TO 4"x4" POSTS SET AT LEAST 3'-0" IN THE GROUND AND TAMPED. CENTER OF SIGN TO BE 3.5' ABOVE GROUND. THE ROAD CLOSED SIGN (STD. CS2 OR CS2R) MAY, AT THE CONTRACTORS OPTION, BE FASTENED TO 4"x4" POSTS AS SPECIFIED ABOVE OR MOUNTED ON THE PORTABLE SUPPORTS AS DETAILED AT LEFT.

Approved August 15, 1947
R. A. Willcomb
ADMINISTRATIVE AID.

Montana State Highway Commission.

STANDARD SUMMARY NOTES

GRADES	For relation of profile grade to sub-grade see typical section.
EMBANKMENT	Quantities shown on plans include shrinkage.
SHRINKAGE	See Std. 54 - 3F
BORROW	Borrow pits or source of borrow to be designated by the Engineer.
OVERHAUL	Free haul limit is 500 feet.
GUARD RAIL	Standard guard rail to be placed on all dangerous curves & fills as designated by the Engineer.
SNOW FENCE	Standard snow fence to be placed as designated by the Engineer.
WASTE	Waste to be disposed of as directed by the Engineer.
WIDENING	See Std. 216 - G5
SUPERELEVATION	See Std. 216 - G5
PROJECTIONS	All projections to be checked in field with reference to the staked or located line.

REV. AUG. 15, 1947.

Approved March 31, 1947

T. A. Willcomb

ADMINISTRATIVE AID

Montana State Highway Commission.

SHRINKAGE FACTORS FOR GRADING QUANTITIES PER STATION UNCLASSIFIED

FOR SWELL ON ROCK - SEE PLANS

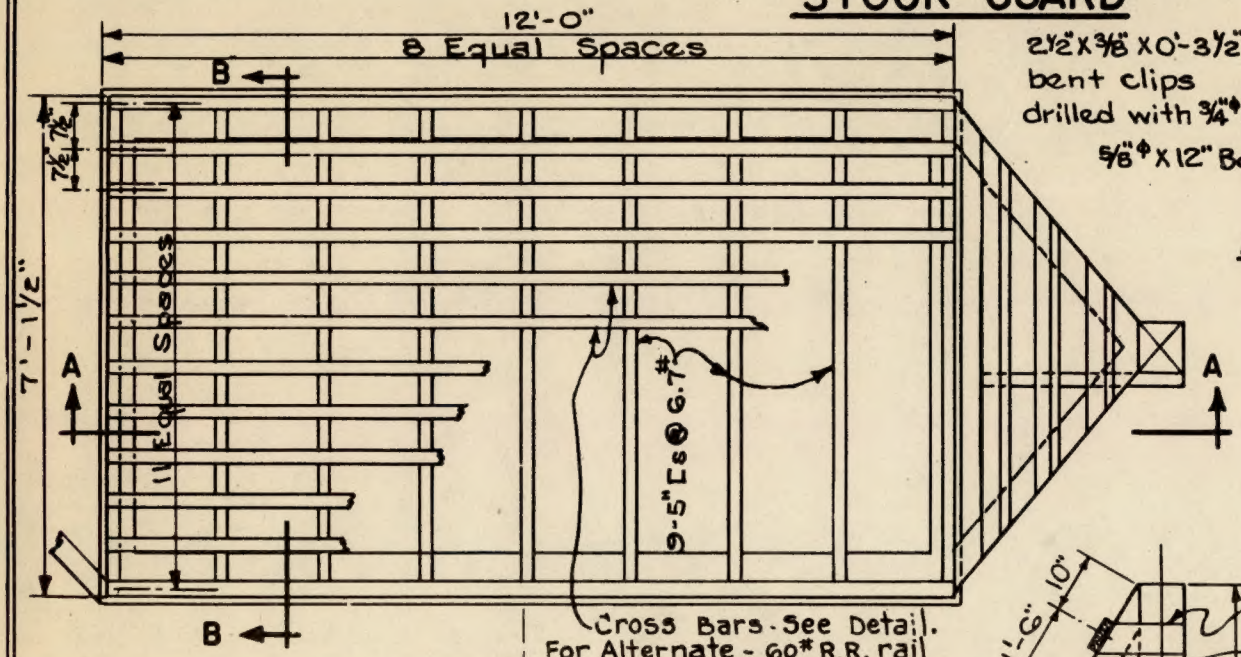
CU. YDS.	TO	CU. YDS.	%
1		100	35 %
101		300	25 %
301		700	20 %
701		1000	15 %
1001 UP			10 %

Montana State Highway Commission.

Approved AUG. 15, 1947
D. M. Willcomb
ADMINISTRATIVE AID

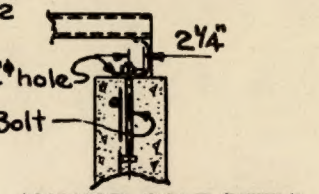
54 - 5F

STOCK GUARD

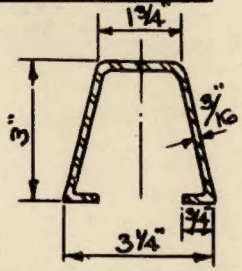


PLAN

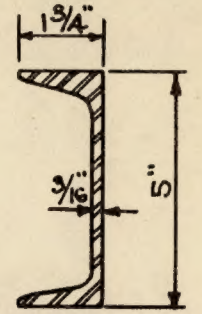
SECTION A-A



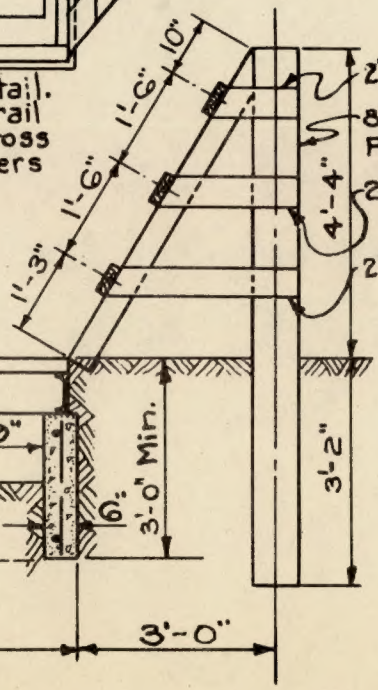
ANCHOR BOLT DETAIL

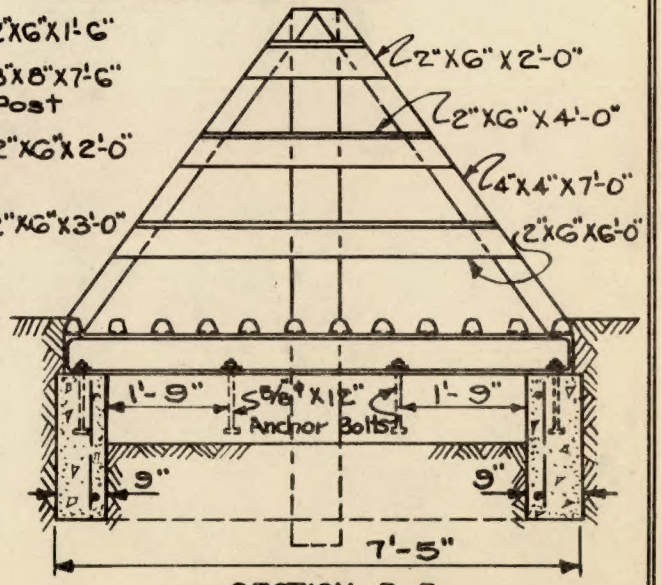


SECT. THRU CROSS BAR



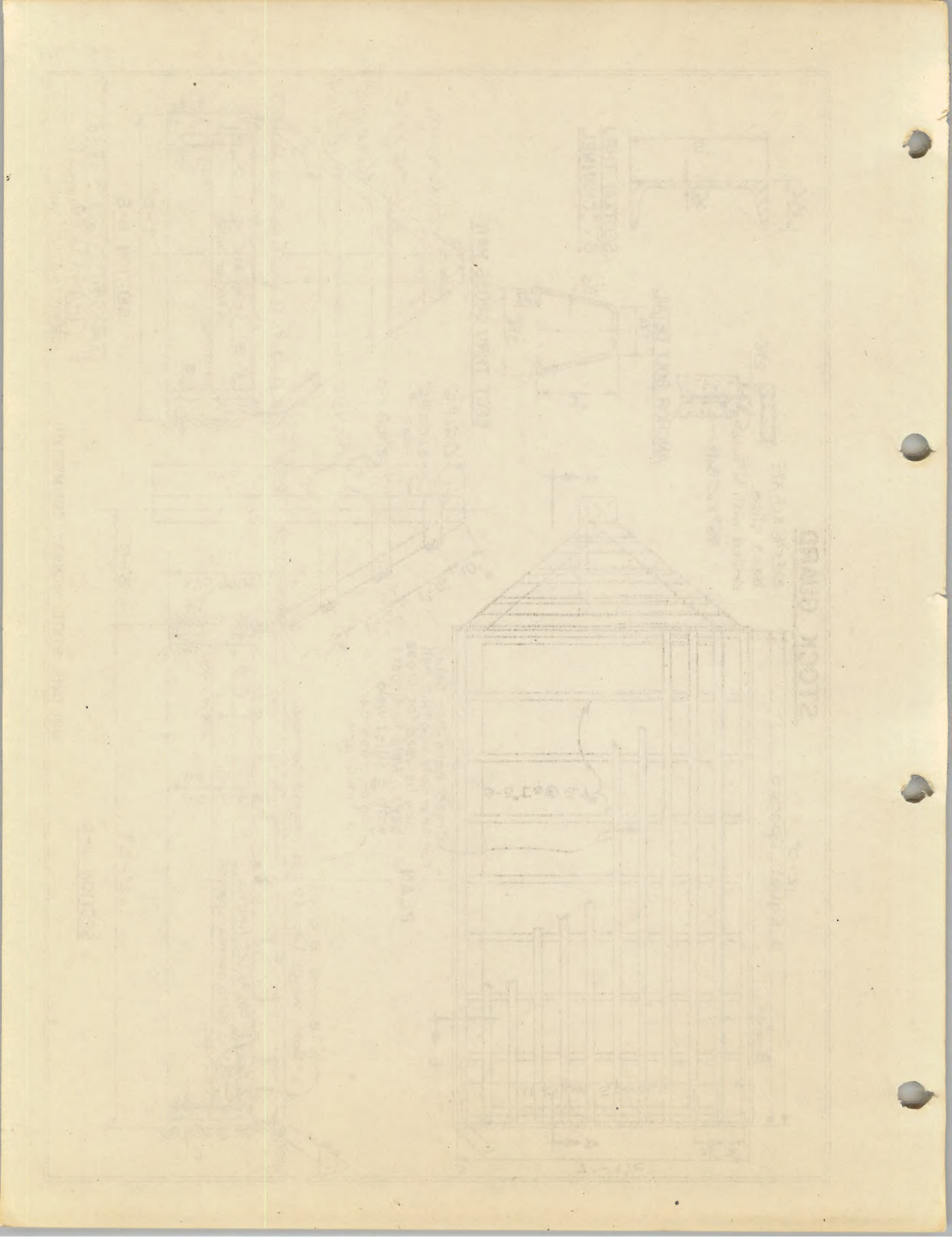
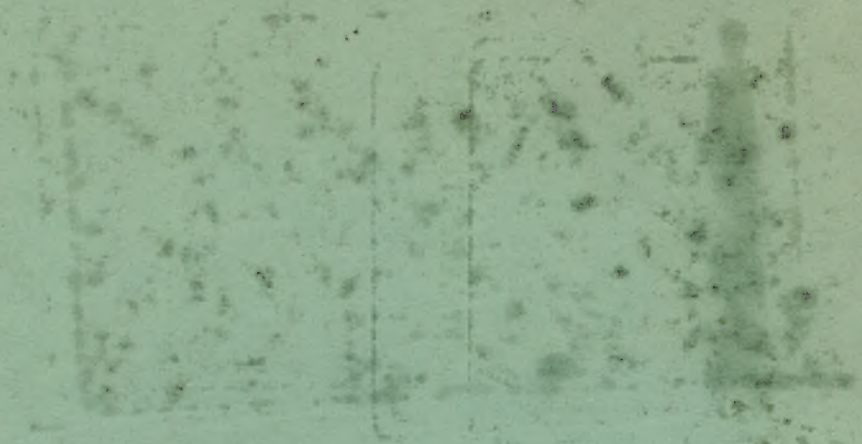
SECTION THRU
6.7# CHANNEL





SECTION B-B

MONTANA STATE HIGHWAY COMMISSION

APPROVED April 3, 1948
T. A. Willcomb
ADMINISTRATIVE AID

55-56